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POSTCAVAL URETER*

Report and Discussion of a Case with Successful Surgical Repair

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POSTCAVAL ureter, also known as "circumcaval" or "retrocaval" ureter, is a congenital anomaly, primarily of the vascular system, that has been recognized and reported with increasing frequency in the past ten years. However, since the original description of the first observed case by Hochstetter[1] in 1893, the total of published cases to date is still less than 40. Thus, the condition may be considered among the more unusual and infrequent of clinical entities. Inasmuch as an accurate preoperative diagnosis was made in only 4 of the previously reported 17 cases found at surgical exploration, we consider it worth while to report still another case of this anomaly, in which the correct diagnosis was established preoperatively and in which a good result was obtained after ureteroplasty.

CASE REPORT

R. G. M. (C.V.A.H. 8853), a 26-year-old male student, was admitted to the hospital on March 22, 1948, for further urologic study. The patient stated that for the past year he had noted fatigue, lassitude and loss of stamina. There had been no abnormal urinary symptoms, no backache and no fever or chills. He had consulted his physician, who had found a mild secondary anemia and had prescribed iron tablets. When several urinalyses had shown microscopic hematuria, he was referred to a urologist for investigation. Cystoscopy and retrograde pyelography had been carried out, and hospitalization was advised. A hydronephrosis of the right kidney and deviation of the right ureter had been noted.

The past history was noncontributory. The system review revealed only a history of long-standing hay fever and a sensitivity to sulfadiazine.

Physical examination was negative. The blood pressure was 120/80. Neither kidney was palpable, and no evidence of any abnormality was noted in the genitalia or prostate.

Repeated examinations of the voided urine revealed no abnormalities. The hemoglobin was 15.8 gm. per 100 cc., and the white-cell count was 9950, with a normal differential. The nonprotein nitrogen was 30 mg., the fasting blood sugar 120 mg., and the total serum protein 5.6 gm. per 100 cc. The blood serologic findings were negative. A roentgenogram of the chest was normal.

On the 2nd hospital day cystoscopy was carried out. The bladder and vesical outlet were normal. No. 6 catheters were easily passed up both ureters, on the left for a distance of 27 cm. and on the right for approximately 32 cm. Urine flow was clear and dilute and more rapid on the right side. Analyses of urine from the bladder and left kidney were normal. The urine from the right kidney contained 25 to 30 red cells per high-power field. Cultures of the urine from the bladder and both kidneys yielded no growth of organisms. After intravenous injection of phenolsulfonphthalein, the dye appeared from the left catheter in 6 minutes, and in the following 10 minutes the kidney excreted 10 per cent. On the right side the dye appeared only after 25 minutes, with 5 per cent excretion in the following 10-minute specimen. The delayed appearance on the right side was thought to be due partially to poor drainage from the catheter. Retrograde pyelography was then performed, anteroposterior stereoscopic and right-oblique views being included (Fig. 1 and 2). The left pyeloureterogram was normal; the right presented a deformity characteristic of postcaval ureter. The renal pelvis

FIGURE 1. *Anteroposterior Pyelogram, Showing the Preoperative Appearance of the Right Upper Tract.*

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and upper third of the ureter were dilated, the dilatation of the ureter terminating quite abruptly at the lateral margin of the spine in the region of the body of the 3rd lumbar vertebra. At this site the ureter passed medially and then arched downward in front of the vertebras to the approximate level of the sacrum, where its position and contour again became normal. After removal of the catheters, a 30-minute drainage film showed considerable retention of contrast medium above the point of angulation of the ureter.

A diagnosis of right postcaval ureter was made, and because of the obstruction and resulting reduction of renal function surgical exploration was advised and accepted. A delay was encountered because of an incidental upper respiratory infection. On the 15th hospital day a ureteroplasty was performed through a curved posterolateral lumbar incision made

FIGURE 2. *Right-Oblique Pyelogram, Showing the Preoperative Appearance of the Right Upper Tract.*

under spinal anesthesia. After reflection of the posterior peritoneum medially, the right renal fossa and the retroperitoneal space below it to the level of the iliac vessels were easily exposed. The kidney was of essentially normal size, shape and consistence. It was not unusually mobile. The dilated pelvis and ureter were dissected free and followed downward and medially to the point where the ureter passed behind the vena cava approximately at the level of the third lumbar vertebral body. A ureter of normal size was then encountered as it emerged from behind the vena cava. A downward descent of the normal ureter across the anterior surface of the cava was noted for approximately 6 cm., at which point it swung laterally and assumed its normal position. No evidence of a definite venous crotch caused by a lumbar vein could be found. In freeing of the lower segment attention was paid to preserving as much of the periureteral tissue as possible. A mesentery-like flap of tissue was actually developed on the medial side, and this was thought to contain a considerable portion of the ureteral blood supply. Division of the ureter was carried out in the dilated segment just above the postcaval portion, and the segment was then easily withdrawn from behind the vena cava with the lower ureter. A 3-cm. segment consisting of the postcaval portion was excised. The entire ureter now readily swung laterally to its normal position. End-to-end anastomosis was accomplished with interrupted No. 0000 plain catgut atraumatic sutures approximating serosa to serosa. Diversion of the urinary stream was carried out by means of a No. 18 Fr. Foley catheter inserted into the renal pelvis well above the anastomosis. No splinting catheter was used at the site of anastomosis. An empty Penrose drain was placed in the renal fossa. The patient withstood the procedure well. Microscopical examination of the excised portion of ureter showed a normal organ.

The postoperative course was uneventful. The temperature, pulse and respirations returned to normal on the 3rd postoperative day. The pyelostomy catheter functioned well until its removal on the 11th postoperative day. Prior to removal, injection of Diodrast through the pyelostomy tube had shown good drainage through the ureter. The ureteral position was now essentially normal. The pyelostomy sinus closed within 3 days of removal of the catheter. Urinalysis at this time showed up to 200 white cells per high-power field in the sediment. On the 17th postoperative day the patient was sent home on a 2-week leave of absence with

FIGURE 3. *Postoperative Appearance of the Right Upper Tract.*

a completely healed wound and no symptoms referable to the urinary tract.

On the 33rd postoperative day cystoscopy was performed for study of the site of anastomosis. A No. 8 catheter readily passed the entire length of the right ureter into the pelvis. The urine from the right kidney contained many white cells, and culture yielded a growth of *Aerobacter aerogenes*. Pyelography showed an area of constriction at the site of anastomosis and an indentation at the point of pyelostomy. Drainage films demonstrated a moderate retention of contrast medium after 30 minutes. The patient was discharged on routine doses of Mandelamine with instructions to continue the medication for 4 weeks.

Three months after operation the patient returned for a routine checkup. He had no complaints and stated that he felt in excellent health. Physical examination showed a well healed wound and was otherwise negative. Laboratory studies revealed a normal blood picture and urine. Cystoscopy was again performed, and a No. 10 catheter easily passed the

entire length of the right ureter. Retrograde pyelography disclosed ironing out of the previously noted areas of operative scar (Fig. 3). The urine from the right kidney was normal, and no growth was obtained on culture. The patient was discharged from the hospital to be followed at regular intervals. Nine months after operation repeat urologic study revealed a slight decrease in the degree of hydronephrosis, no stricture at the site of anastomosis and a normal urine. One year after operation, when this paper was written, the patient reported that he was well and free of symptoms.

Review of Cases

In 1940 Pick and Anson[2] collected a series of 26 cases of circumcaval ureter from the literature and added 1 of their own. Since their review 11 other cases have been reported.[3-13] The case reported above brings the total number to 39. Of these 39 cases, 29 were in males, 8 were in females, and in 2 cases the sex was not given. It has been suggested that the high incidence among males (more than 3:1) is best explained by the greater number of male bodies that come to the dissection table and postmortem examination, where a majority of the cases in this series were discovered. With the exception of 3 infants one year of age or less, all cases were in the age range of twelve to eighty-four years, the youngest male and female being sixteen and twelve years of age respectively, whereas the oldest male and female were eighty-four and seventy-two years of age respectively. In 21 of the 39 reported cases the condition was discovered either at the laboratory dissection table or at autopsy. It has been postulated that this figure gives an incidence of 1 case per 1600 cadaver dissections.[14] In the remaining 18 cases the anomaly was recognized at surgical exploration, but in only 5 of this group was a positive diagnosis of postcaval ureter made before operation. Harrill,[4] Greene and Kearns,[8] Goyanna et al.[10] and Creevy[13] described the first 4 cases in which a correct preoperative diagnosis was established, and our case brings the total to 5. In the past ten years, at least 12 cases have been found at operation, and this in itself is indicative of the aroused clinical interest in the condition.

Embryology

This aspect of the subject remains one of the more complicated and yet more fascinating parts of the entity. Although clinical symptoms and signs are those of renal obstruction and infection, the basic cause of the condition is a faulty development of the inferior vena cava. The urinary-tract involvement in this vascular anomaly stems from the fact that as the metanephros (the permanent kidney) rises from its pelvic to its lumbar position, it passes through a ring of embryonic venous channels (periureteric ring). We have tried diagrammatically to explain this in a simplified fashion in Figure 4. For a detailed discussion of the embryologic development of the abdominal vena cava the reader is referred to the fundamental work of McClure and Butler[15] and Butler,[16] and to the subsequent comprehensive reviews of the subject in other papers by Pick and Anson,[2] Gruenwald and Surks[6] and Randall and Campbell.[17] In brief, it is known that, in early embryonic life, there are three sets of bilaterally symmetrical venous channels, parts of which are later destined to form the permanent vena cava, and in other parts of which atrophy and play no further role in development of the fetus. Since all but 1 of the 39 patients had a right-sided postcaval ureter, Figure 4 shows only the right-sided part of this system viewed from the ventral aspect. The postcardinal vein is noted to be the most lateral and ventral, the supracardinal the most dorsal, and the subcardinal the most medial. The periureteric ring is completed by the anastomoses between these vessels. Its ventral limb consists of the lumbar division of the postcardinal vein and the subcardinopostcardinal anastomosis, whereas the lumbar division of the supracardinal vein and the subcardinosupracardinal anastomosis form the dorsal limb. Normally, the dorsal limb persists as the adult vena cava, and the ureter is thus antecaval. It becomes obvious that with two limbs involved, three possibilities arise: persistence of the ventral limb alone, with resultant postcaval ureter; a similar result from failure of development of a dorsal limb; and persistence of

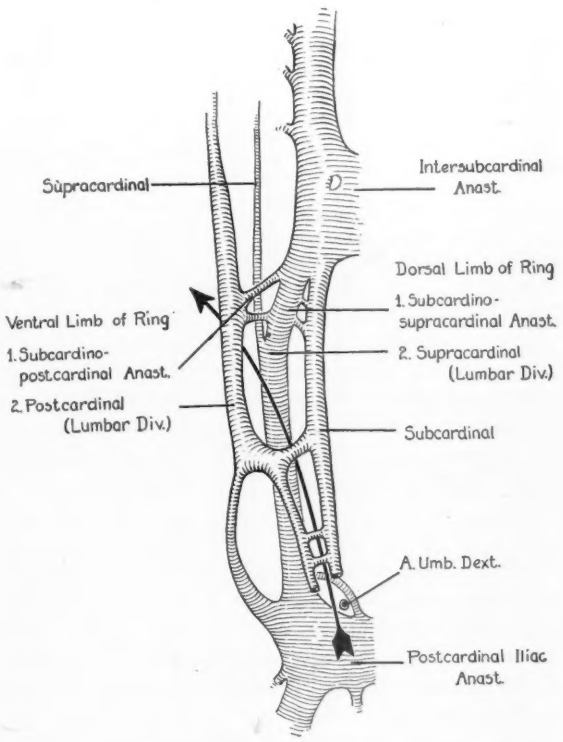

FIGURE 4. *Schematic Diagram of the Lumbar Venous System of a 15-mm. Human Embryo, Showing the Relation of the Ascending Kidney and the Units of the Periureteric Ring. The arrow indicates the route that the kidney takes in its ascent to the renal fossa (adapted from McClure and Butler[15]).*

both rings, with a double right vena cava and interposed ureter. When it is appreciated that similar possibilities exist on the left side, it is evident that a considerable assortment of anomalous combinations may occur. To complicate matters, it is thought that in some cases abnormally developing spermatic or ovarian veins may be involved in the process.

Analysis of the cases we have studied reveals the arrangement, according to type, shown in Table 1.

TABLE 1. *Types of Postcaval Ureter.*

Postcaval Side	Vena Cava	Ring Persistence	No. of Cases
Right	Right single	Right ventral	31
Bilateral	Bilateral single	Bilateral ventral	1
Right	Bilateral single	(Right ventral) (Left dorsal)	4
Right	Right double	Right ventral and dorsal	3

Because surgical cases are rarely explored on the side opposite to that requiring operation, some of these cases may be incorrectly classified.

From a review of these variations, it is evident that, although the right postcaval ureter is three times as common as the other types combined, the chance occurrence of additional anomalies still exists and should be considered in the diagnostic study and treatment of any individual case.

Clinical Aspects

If the pathological physiology of postcaval ureter is understood, it is apparent that there can be no symptom complex peculiar to this entity alone. Because of the anomalous position of the ureter, there is apt to occur a variable degree of chronic partial ureteral obstruction with resultant hydroureter, hydronephrosis or superimposed infection, or both, and calculus formation. Any or all of the symptoms of disease of the upper tract may thus be encountered in this small group of patients. The average patient, however, presents a history of intermittent attacks of flank pain, occasionally chills and fever, hematuria, vague gastrointestinal complaints, malaise, general sense of ill-being and other symptoms suggestive of ureteral obstruction and infection. The duration of symptomatology may be lengthy. On the other hand, symptoms may be lacking and the condition found only on routine pyelographic study.

The cause of the ureteral obstruction has been the subject of much conjecture. Of the 39 cases described in this series, 28 were reported to show some degree of hydronephrosis and hydroureter, whereas in 11 there was no evidence of obstruction or infection at all. In view of the fact that approximately a fourth of the cases showed no ureteric or renal changes, it is apparent that more is involved than mere constriction of the ureter in its abnormal position between the vena cava, the aorta and the vertebral bodies. Pathologically, it has frequently been found that the postcaval portion is the seat of chronic inflammatory changes and stricture formation. The observation of Pick and Anson[2] that the ureter may be caught in a venous crotch formed by the junction of a lumbar vein with the vena cava has subsequently been confirmed in other reported cases. This venous crotch fixes the ureter at a given point and causes acute angulation of the ureter if ptosis of the kidney should occur. The factors involved are thus summarized as stricture, deviation of the ureter from its normal course, constriction between the vena cava and the aorta or vertebras, the presence of a fixing lumbar vein and renal ptosis.

The diagnosis of postcaval ureter is made only by radiologic studies. Cognizance of the condition, however, is an intangible but valuable factor, and the entity should be considered in all cases of ureteral obstruction with hydronephrosis, particularly when the lesion is on the right side. The typical x-ray findings pointed out by Randall and Campbell[17] are classically demonstrated in the films taken in the case reported above (Fig. 1 and 2). The length of the proximal dilated ureter is noted to be increased over that found in the usual type of obstruction. The elongated ureter is seen to be displaced far medially to a position over the bodies of the lumbar vertebras and to assume its normal position only when it has reached its pelvic portion. This lengthening and displacement has resulted in the frequently described sickle-shaped deformity of the ureter. The oblique view is considered to be an almost pathognomonic sign of the condition. The postcaval portion of the ureter is found to impinge upon the bodies of the third and usually fourth lumbar vertebras. The normal ureter will fall away, anteriorly, from the vertebral bodies. These roentgenographic features may be observed in both retrograde and intravenous pyelograms. Today, with the extensive employment of pyelography in routine diagnostic studies, the possibility of this anomaly should be considered in all cases of ureteral displacement, and the diagnosis more frequently made in the future.

Treatment

Since the majority of cases discovered clinically present hydroureter and hydronephrosis, the only feasible course of action is surgical. Attempts at ureteral dilatation by cystoscopic maneuvers are hazardous because of possible ureteral perforation from faulty manipulation, and they are unsound as a method of relieving permanently an angulation type of obstructing ureter. The surgical procedures to be considered are nephrectomy or some type of ureteroplasty. The former is reserved for kidneys so destroyed by infection, calculus disease or hydronephrotic atrophy that the principle of conservation of renal tissue may be disregarded except

when the involved organ is the patient's only kidney. As previously noted, in 18 of the 39 cases of this series the anomaly was recognized at surgical exploration. Of the 18 patients explored, nephrectomy was performed in 6, and a nephrolithotomy only was done in 1, whereas in 11 cases some form of corrective surgical treatment was attempted. Up to 1940 corrective operations had been performed in only 3 isolated cases by Kimbrough,[18] Uebelhör[19] and May.[20] In these cases repair consisted of severing the ureter, withdrawing it from behind the vena cava and uniting it in a more normal location. The result in each case was stated to be good, although the longest follow-up study was only one year, and in 1 case[19] no postoperative pyelograms were reported. Since 1940, 7 additional cases in which corrective repair was attempted have been reported in the literature.[4, 8-13] The case reported above brings to a total of 11 the number in which plastic operations have been performed. Of the 8 patients operated upon since 1940, 6 have had a good result during periods of follow-up study varying from three months[12] to three years,[13] 1 required nephrectomy for stone five months after ureteroplasty,[11] and 1 had a ureterocutaneous transplant two or three months after the first operation.[9] In the last patient, in contradistinction to the other cases in which an almost identical type of plastic operation was carried out, Lowsley[9] severed the ureter just above the bladder, dissected it free to the renal pelvis, withdrew it from behind the vena cava and implanted it into the bladder. Postoperatively, an impermeable stricture of the terminal ureter and a fistula above it developed, these complications and their sequelae eventually necessitating a skin transplantation. To summarize the results of surgical exploration, it is evident that 9 of 18 patients, or 50 per cent of those operated on, had successful correction of the abnormality and preservation of the kidney. With constantly improving technical facilities and the introduction of more effective chemotherapeutic and antibiotic agents, the majority of clinical cases of this anomaly should come to some form of operative correction with even a much greater expectation of a successful result.

It is not within the scope of this paper to discuss the technics of ureteroplasty in detail, but certain features of the subject deserve comment. Any procedure that necessarily severs and transplants a ureter is subject to complications arising from interference with blood and nerve supply and later stricture formation at the site of anastomosis. The former consideration arises during the course of transplantation. Most authors believe that the ureter should be severed proximal to the postcaval portion, the section of ureter in the area of obstruction sacrificed, and the distal ureter swung laterally and anastomosed antecavally. Unless care is taken to preserve the investing layers of the ureter, there is considerable danger of faulty healing or actual necrosis at the site of anastomosis. With division of the ureter the continuity of the intramural plexus of nerves responsible for the advancing peristaltic wave is interrupted and may thereby leave the distal ureter incapable of any function except maintenance of local tonus. As previously mentioned, Lowsley suggested a very low pelvic division of the ureter, withdrawal of the entire lower ureter upward through the postcaval site and then reimplantation of the proximal ureter into the bladder. This has the merit of preservation of nerve contiguity but must radically interfere with the blood supply arising from the vesical and ureteral arteries. The problem of transplantation is thus not solved. It seems reasonable, however, that the preservation of blood supply is of primary importance and is best accomplished by high ureteral division.

A discussion of stricture formation centers about the type of anastomosis to be used and whether or not a splinting catheter is indicated. Although there is justifiable argument by some authorities concerning the matter, the majority believe that temporary diversion of the urinary stream by nephrostomy or pyelostomy is necessary. Anastomoses have been of three types: end-in-end, end-to-end by serosal suture with inversion of edges and end-to-end by mucosal suture with eversion of edges. The first two methods have been used for years and have shown a rather marked tendency toward stricture formation necessitating frequent dilatation. This, of course, leads to a vicious circle of recurrent trauma to the line of suture, more cicatrix and slowly advancing hydronephrosis in approximately a third of the cases. The third type, as advocated by Davalos,[21] has not had sufficient clinical trial for its efficacy to be evaluated. It is essentially the type of repair so successfully used in blood-vessel anastomosis in recent years. It is certainly worthy of trial. The problem of whether or not a splinting catheter should be employed is also the subject of considerable difference of opinion. Davis[22] has shown that in so-called intubated ureterotomy the splint should remain in place at least four weeks if healing is to be complete before its removal. Even with the use of the newer plastic splinting materials, however, the presence of such a foreign body in the ureter for this length of time must inevitably provoke a more active local tissue reaction than if it were absent. This, and the foreign body, may act as inciting causes of secondary infection in a field where sepsis is too frequently a factor of serious import. Thus, the decision not to utilize a splint seems to offer a greater opportunity for clean healing and rapid resumption of normal ureteral function. Harrill[4] has suggested that the stricture problem be circumvented by use of a transverse division through the pelvis just above the ureteropelvic junction. His opinion is that stricture is avoided by anastomosis of the dilated segments of the divided pelvis. This procedure would obviously

be a likely answer were it not for the fact that the postcaval portion of the ureter is not always histologically normal and must of necessity be occasionally resected because of cicatricial changes secondary to its anomalous position. Again, the problem is not solved. The procedure described in the case reported above indicates our preference. Although the eventual outcome is not known, a result with no infection after three months and with a healed anastomosis allowing easy passage of a No. 10 Fr. catheter can be considered satisfactory.

Summary

A case of right postcaval ureter is described, bringing the total number of reported cases of this condition to 39. This is the fifth case in which a correct preoperative diagnosis was made, the eleventh in which plastic repair of the anomaly was attempted and the ninth in which a successful result was obtained.

A summary of the previously reported cases is made, and the embryologic development of the anomaly reviewed.

Some pertinent features of diagnosis and treatment are discussed, and a preference for high ureteral division, anastomosis without splinting, and temporary diversion of urine by pyelostomy is indicated.

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THIOCYANATE EFFECT FOLLOWING INDUSTRIAL CYANIDE EXPOSURE*

Report of Two Cases

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THE purpose of this report is to encourage clinical interest in detoxification mechanisms of the body in general. Specifically, the remarkable facility with which the highly toxic cyanide ion is converted to the relatively nontoxic thiocyanate ion is considered. This physiologic process may account for the fact that industry has been able to use large quantities of cyanide salts with comparative safety. The ease with which hydrogen cyanide, when generated, causes tissue anoxia and death has resulted in the adoption of the low figure of 10 parts per million (p.p.m.) as the safe breathing level of workers exposed to this toxic material. In addition to inhalation, hydrogen cyanide is absorbed readily through the unbroken skin and from the gastrointestinal tract. These facts present great protection problems in industrial use. Hydrogen cyanide is liberated from cyanide salts in the presence of acid.[1] At the level of 10 p.p.m. or under, the ability of the body to convert cyanide to thiocyanate is, in most cases, capable of preventing cyanide intoxication. The thiocyanate ion, like the chloride and bromide ions, is distributed extracellularly and is in no way altered in the body. The thiocyanate formed is excreted irregularly by the kidneys, and hence may accumulate in the body with steady intake of cyanide or thiocyanate.

Many small industries making tools, silverware and dies use a liquid bath of a cyanide salt to harden the material employed by dipping the article when it is red hot into such a solution. Such an operation, referred to as case hardening, may generate hydrogen cyanide. In addition, inhalation of dust containing cyanide salts is a worker hazard of this operation. To establish the fact that case hardeners do excrete thiocyanate after cyanide exposure, certain field studies were undertaken by the Massachusetts Division of Occupational Hygiene. In

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recent years (1937 to the present), the Division has studied many case hardening processes and found that with adequate engineering devices, the hydrogen cyanide in the workers' breathing zone is not over 4 to 6 p.p.m. Ruotolo, one of the chemists of this group, has found that workers exposed to cyanide as hydrogen cyanide consistently excrete low levels of thiocyanate, the averages ranging from 6 to 13 mg. of thiocyanate per liter. These determinations were made on spot samples. The group studied included 25 workers exposed to cyanide salts in a similar manner to that in Case 1 reported below. Three workers showed no thiocyanate in their urine, and in 3 others the levels were 21, 22, and 29 mg. per liter. It is known that heavy smokers and persons who take large amounts of cabbage-like vegetables or mustard excrete small amounts of thiocyanate. In a study of 10 spot urinary samples from 5 nonindustrial controls, Ruotolo got values varying from 0 in nonsmokers to 23 mg. per liter in a man who smoked two packages of cigarettes daily. Sollmann[2] says that tobacco, if used heavily, will increase the serum thiocyanate level two to four times that of nonsmokers. In view of the known irregular rate of excretion of thiocyanate, these data serve merely to indicate that workers inhaling cyanide do excrete thiocyanate. No correlation can be safely made between these values and degree of exposure.

Two cases are presented below as reasonable clinical evidence that an occasional worker in the case-hardening industry may experience symptoms related to his exposure to cyanide, in part perhaps because excretion of the thiocyanate formed is not efficient.

Case Reports

Case 1. A. Y., a 59-year-old case hardener, was first admitted to the Massachusetts General Hospital in June, 1943, complaining of persistent headache, pains in the anterior part of the chest and inability to work since an episode of vertigo and weakness 4 months previously.

He had been born in Austria near the Swiss border and had come to the United States in 1910 at the age of 26, obtaining a job as a case hardener in a Massachusetts steel mill. This work involved the use of cyanide, and he was allegedly almost constantly exposed to fumes resulting from the process.

In 1920 he began to have headaches and episodes of dizziness, which gradually increased in severity. One day 5 years later, when driving his car home from a physician's office, he became sufficiently confused not to recognize his wife. During the next 17 days he was hospitalized because of weakness. He was barely able to move his arms and legs, his vision was poor, his speech was slurred, and he was incontinent of urine and feces. After a prolonged convalescence at home, he recovered normal motor function, with no residual effects other than nervousness.

He did not return to his old job, but from 1925 to 1941 he worked as a truck driver and later as a baker, without further symptoms.

In 1941 he returned to the work of case hardening. He soon experienced a return of headaches and generalized weakness, associated with coughing and sneezing, and occasional cramping pains in the lower abdomen. There were frequent episodes of coarse tremor of the arms and to a less extent of the legs and head. Weakness increased, and in January, 1942, he was hospitalized for 2 weeks for "heart trouble." He was able to return to work 8 weeks later, but the symptoms of headaches, cough, sneezing, and tremor soon recurred, as well as occasional nausea and vomiting at work.

In February, 1943, while on his job, he suddenly became dizzy, his right side became paralyzed, and he fell to the floor. He retained consciousness, but was unable to speak. For 24 hours, his extremities were paralyzed, but recovery gradually occurred over the ensuing 3 weeks. The blood pressure was 176/104; 10 days later the reading was 140/98, and 3 weeks later it was 130/85.

Because of persistent severe headaches, generalized weakness, easy fatigue and pain in the anterior part of the chest produced by effort and relieved by rest, he did not return to work. A weight loss of 10 pounds occurred despite a good appetite. A persistence of these symptoms for 4 months led to admission to the hospital.

The following additional pertinent features of his history were recorded: he had always perspired easily and profusely, but there was no definite intolerance for heat. No goiter or palpitation had been noted. He had always been fond of sauerkraut and cabbage, taking rather large quantities of these vegetables in his diet. His family history was not remarkable except for the fact that his father had had a large, apparently nontoxic, goiter.

Physical examination revealed a well developed and well nourished man in no acute distress. There was a coarse palpable tremor of the entire body and a fine tremor of the hands. An erythematous, vesiculopapular, slightly pruritic rash involved the trunk, axillas and extremities. Hearing was slightly impaired. A slight lid lag was present bilaterally, but there was no gross exophthalmos. The fundi showed increased tortuosity of the vessels, with slight arteriovenous nicking. There was moderate pyorrhea alveolaris. The thyroid gland was approximately twice the normal size, with a large, firm nodule behind and to the left of the sternal notch. No bruit was present. The heart rhythm was grossly irregular, and the rate was 120 per minute at the apex and 90 per minute at the radial artery. A soft systolic murmur was heard at the pulmonic area. The blood pressure was 140/75. The palms were warm and moist, but the feet were cold. There were bilateral herniorrhaphy scars. Neurologic examination revealed that the biceps and knee-jerk reflexes were slightly stronger on the left side than on the right; the abdominal reflexes were absent on the right, and there was no ankle clonus. Babinski reflexes and vibration sensation were normal.

Urinalysis and a complete blood count revealed no abnormalities. The serum nonprotein nitrogen was 30 mg., the protein 6.8 gm., and the cholesterol 196 mg. per 100 cc. No cyanate or bromide levels were found in the blood. An electrocardiogram revealed auricular fibrillation, with a rate of 110 and a mild digitalis effect. The initial basal metabolic rate was +30 per cent, but subsequent tests varied between +10 and −8 per cent without treatment. An x-ray film of the chest showed enlargement of the left ventricle and a tortuous aorta. The lung fields were clear. A lumbar puncture demonstrated a normal cerebrospinal fluid, including serologic findings.

The initial diagnostic impression was hyperthyroidism with possibly a former cerebrovascular accident, but after several normal determinations of the basal metabolic rate and failure to respond to a therapeutic trial of potassium iodide, 10 drops daily, the former diagnosis was thought to be unlikely. The patient was discharged a month after admission on a regime of digitalis and potassium iodide, 10 drops daily, with a diagnosis of questionable chronic cyanide poisoning or questionable Parkinson's disease. He was feeling somewhat stronger, and his cough had diminished, but the body tremor, nervousness and sweating continued unchanged. The skin eruption gradually cleared.

In the summer of 1944 he returned to work for the same company, but was assigned to passing out tools instead of returning to operations involving the use of cyanide. Over the next 2 years his symptoms remained essentially the same, except that on one occasion when he omitted digitalis for 3 months there was a subsequent increase in nervousness, dizzy spells and suboccipital headaches associated with rapid, uncontrolled auricular fibrillation, but without cardiac decompensation. The blood pressure averaged 165/100. In July, 1946, the serum protein-bound iodine was 6.1 gamma per 100 cc. (normal 3.5 to 7.5 gamma) and cholesterol 212 mg. per 100 cc. (normal 90 to 140 mg. per 100 cc.).

Two years later, he was readmitted to the Massachusetts General Hospital for re-evaluation of his thyroid status. He still complained of episodes of dizziness and sweating, nervousness and tremor. In addition, he stated that memory for recent events had become impaired during the past 4 or 5 years. Physical examination revealed a meek, nervous 62-year-old man, who was sweating profusely but whose hands were cool. Slight bilateral lid lag was present. The right pupil was irregular and larger than the left. A coarse tremor of the tongue and both coarse and fine tremors of the hands were noted. The thyroid gland was two or three times the normal size and multinodular, with a small firm nodule approximately 0.7 cm. in diameter in the right lateral lobe. The heart was slightly enlarged, fibrillating as before, with a blood pressure of 175/100 and no murmurs. Routine urinalysis was normal. The red-cell count was 6,200,000, and the hemoglobin 16.5 gm. per 100 cc. The nonprotein nitrogen was 29 mg., the total protein 6.7 gm., and the cholesterol 250 mg. per 100 cc. The blood Hinton test was negative. A glucose-tolerance test showed a fasting level of 114 mg. per 100 cc. 174 mg. at 30 minutes, 200 mg. at 1 hour, 184 mg. at 2 hours and 156 mg. at 3 hours. The basal metabolic rate ranged from +29 to −6 per cent without treatment. An x-ray film of the chest revealed no evidence of substernal goiter and no change in the past 3 years. A metastatic series showed no bony metastases.

A subtotal thyroidectomy was performed on October 1, 1946, because of the possible development of cancer in the nodular goiter. At operation a multinodular goiter was removed. The pathological report was "struma nodosa micro et macro folliculare with a fetal adenoma showing early malignant change in the right lobe." The postoperative course was uneventful on a regime of digitalis and elixir of phenobarbital.

On his last visit 2 years later the patient had no complaints. He has had no further contact with cyanide, working at present as a night watchman.

Case 2. R. B., a 36-year-old machinist, was first seen at the Medical Clinic of the Out-Patient Department of the Massachusetts General Hospital on November 20, 1948. His chief complaint was an enlarging mass in his neck of 8 years' duration. He had been in good health until 1940, when he obtained a position in a machine shop where cyanide was used for case hardening steel. After a 5-month period of frequent exposure to cyanide in the "hardening room," he noted a swelling in his neck. Shortly thereafter, his physician started him on iodine therapy, which he continued to take regularly for the next 2 years. On this treatment he felt well and gained approximately 32 pounds. The size of the thyroid gland remained the same. Frequent industrial exposure to cyanide continued. From the end of 1942 until October, 1948, he had intermittent and less frequent exposure to cyanides. However, he continued to eat his lunch regularly in the "hardening room," where, according to the worker's account, dust considered to be cyanide laden filled the air, since the work was continued during the noon hour. In the latter part of 1942, he stopped iodine therapy. The thyroid gland gradually increased in size. He resumed iodine therapy 2 years later in 1944, but this did not effect any change in the size of the gland. He then complained of excessive perspiration, easy fatigability and headaches over the vertex. From 1945 to 1948, he received "various pills" from his physician, without noticing much improvement. Several weeks prior to his visit to the Out-Patient Department, he complained of nervousness, headache, increased irritability, profuse perspiration and palpitation. His physician presumably suspected hyperthyroidism and instituted propylthiouracil therapy, 50 mg. per day for a period of 2 weeks. Shortly thereafter, the goiter increased in size, and he complained of slight difficulty in swallowing. He was then referred to the Out-Patient Department of the Massachusetts General Hospital.

The patient had been born and bred in Massachusetts. His diet included sea food at least once a week. He was doubtful regarding the use of iodized salt. There was no history of excessive ingestion of cabbage. He had been a "heavy pipe smoker" until 1945. The past history was otherwise not remarkable, except for mumps during childhood.

A sister had apparently had a simple colloid goiter, which had improved on medical management.

Physical examination showed a short and stocky man. There was a slight lid lag bilaterally, with some difficulty on convergence, the right eye deviating laterally. The fundi were normal. The skin, hair, nails and voice were normal. The thyroid gland was diffusely but asymmetrically enlarged and slightly firm. The right lateral lobe was approximately two and a half to three times, and the left lateral lobe about four times the normal size. The isthmus was approximately four times the normal size. The pyramidal lobe was palpable and extended about 5 cm. above the isthmus. In the pyramidal lobe and close to the isthmus were two small, tender nodules about 0.8 cm. in diameter. The gland was otherwise not tender on palpation, and the whole gland moved on swallowing. There was no substernal extension of the gland, and no bruit or thrill was present over it. There was no tremor of extended fingers. The pulse was regular at 82, and the blood pressure was 138/84. The remainder of the physical examination was negative.

Repeated determinations of the basal metabolic rate ranged from −9 to +6 per cent. A hemogram and urinalysis were normal. The blood cholesterol was 276 mg. per 100 cc. A barium swallow showed slight indentation of the left side of the trachea in the region of the first thoracic vertebra. There was an increase of the soft tissues anterior to the trachea at this level. The esophagus was not displaced. There was no substernal extension of the mass.

He was started on 100 mg. of thyroid (*U. S. P.*) on July 27, 1949. On this treatment he began to have more energy, but complained of some palpitation on moderate exertion. In 2 months there was no noticeable decrease in the size of the gland. He was last seen in the Thyroid Clinic on October 29, when his only complaint was easy fatigability. The thyroid gland was thought to be slightly smaller than on the previous examination, but it was difficult to be certain of this. It was decided to increase the thyroid dosage to 160 mg. per day. This was considered a probable case of thiocyanate goiter in retrospect.

Discussion

There are a few reports in the literature of signs and symptoms of intoxication following repeated occupational exposure to hydrogen cyanide or cyanide salts, which support the idea that the patient in Case 1 suffered chronic cyanide poisoning. Martin,[3] in 1888, reported the case of a twenty-one year-old servant who applied a silver coating containing the double cyanide of potassium and silver to antiques. As she continued at this work and subsequent polishing, she experienced great weakness, severe abdominal pain, vomiting, headache and ataxia. Merzbach[4] described the case of a worker in a printing shop who placed copper plates in a solution of cyanide salts and then passed a galvanic current through the solution, which released hydrogen cyanide as a fume. After a year, severe gastrointestinal symptoms and disturbance of the whole nervous system, including the intellect, resulted in complete disability, and death within two years of cessation of cyanide exposure.

Collins and Martland[5] reported a disease of the primary motor neurons causing the clinical picture of acute anterior poliomyelitis, the result of poisoning by potassium cyanide. The patient was a sixty-eight-year-old Italian working in a hotel who polished silver by dropping it into a potassium cyanide solution, after which he dried it. He had severe pruritus and brownish-red pigmentation of the forearms. Great vertigo and signs of meningitis were followed by loss of power in legs and arms. Improvement came slowly after six months. The

authors followed this up with an experiment on 4 rabbits, in which they gave potassium cyanide intravenously and observed lesions of the anterior-horn cells after two weeks. There was also myelin degeneration in the peripheral nerves.

Parmenter[6] described a photographic worker at the Massachusetts General Hospital who suffered from numbness, weakness, vertigo, nausea, tachycardia, headache, flushing of the face and gastric distress while working over a sink containing potassium cyanide and ferrous sulfate. Souwers[7] reported on another photographer who, during the course of exposure to a solution of potassium cyanide, exhibited listlessness, sleeplessness, lumbar pain, anorexia, nausea, constipation, chills, dyspnea and slowed pulse. These symptoms cleared when he ceased work and returned on resumption of cyanide exposure.

Two of the 3 cases reported by Smith[8] from New York State in 1932 qualify as examples of chronic cyanide poisoning. In 1 case, the worker had been a gold plater for twenty years, ten of which he had spent in a small shop provided with insufficient ventilation. He was first bothered with a rash on his arms, hands and face. Coincidentally, he had spells of nausea and vomiting. After a prevacation rush of business, he was seized with violent abdominal pain and convulsions, which recurred with renewed exposure to the potassium cyanide solution. He gave up work, incapacitated by weakness, weight loss, headache, vertigo, muscular cramps and recurring abdominal pain and vomiting. The second worker had been a case hardener for fifteen years. He had such weakness and vertigo that he fell down. Weight loss and muscle weakness involving the arms and legs followed to such a degree that he had to give up work. Ullmann[9] investigated the cause of general malaise and headaches in several girls employed in a shoe store in Germany and found a considerable quantity of cyanide in a fluid shoe cleaner.

Nolan[10] reported mild poisoning in workers exposed to potassium cyanide during gold extraction. There was heavy exposure because the workers kept their arms in the solution during the operation. In spite of this, only a few were affected. Cold weather seemed to accentuate the symptoms in this group. A local rash was common. Slight giddiness and headache were the symptoms reported.

There are a few pertinent animal studies, in addition to the work by Collins and Martland referred to above. Ferraro,[11] using large doses of potassium cyanide in animals, noted large areas of partial or complete demyelination in the brain and spinal cord, as well as definite areas of meningoencephalitis in some. Tolone[12] using much smaller doses than Ferraro, failed to confirm Ferraro's findings; in his animals, lesions affected chiefly the anterior-horn cells of the spinal cord and the granular layer of the cerebellum. Hurst[13] has shown that with or without necrotic lesions in the gray or white matter, areas of demyelination may occur in the white matter of the brain of monkeys poisoned by repeated doses of potassium cyanide. Because of the rapid detoxification of cyanide in the animal body, he inferred that cyanide does not act cumulatively in the sense that its concentration steadily rises to a level injurious or fatal to the animal, but rather that each dose leaves its trace of damage, and that the final result is cerebral demyelination.

Study of the reports of the toxic effects of thiocyanates in the treatment of hypertension by Wald et al.,[14] Barker,[15, 16] Garvin[17] and others brings out striking similarity to the clinical course of Case 1 and to the cases of so-called chronic cyanide poisoning in industry already discussed. Vertigo, headache and great weakness are the most common complaints in all these reports, including the present one. The patient in Case 1, after fifteen years in the case-hardening industry, had an attack of mental confusion, motor aphasia and slurred speech, from which he recovered. After fifteen years of good health, he returned from work as a truck driver and baker to cyanide exposure, and his symptoms returned. Coughing and sneezing were among his complaints, recalling the fact that one of the actions of the thiocyanate radical is iodide-like, causing mucous-membrane reactions, such as coryza.

As he continued his cyanide exposure, this patient complained of muscular tremors and gastrointestinal symptoms, which increased in severity until vomiting and abdominal cramps, in addition to the weakness and headache already mentioned, were almost completely disabling. Two years after the renewed cyanide exposure at the age of fifty-nine years, he had a left hemiplegia, from which he recovered in three weeks. Wald et al.[14] report such episodes in hypertensive patients being treated with thiocyanate as being due to relative hypotension causing vascular insufficiency. The varying blood pressures reported during the hospital stay in Case 1 may be significant with this in mind. The patient subsequently suffered anginal pain, which has been discussed as a possible toxic side-effect of thiocyanate therapy. By the time he had been away from his cyanide exposure for a year and on potassium iodine, he felt better.

A number of carefully studied cases of goiter following thiocyanate therapy for hypertension have been reported, and we suggest that the patients in the 2 cases reported above had such thiocyanate goiters after industrial exposure to cyanide salts. Acute diffuse goiter with pain and myxedema, acute enlargement of an adenomatous nodule and chronic diffuse goiter have been observed.[18-22] Such thiocyanate goiters have been described as occurring after four months or more of therapy and have occurred at blood thiocyanate levels as low as 4.7 mg. per 100 cc. after ingestion of 0.3 gm. of potassium thiocyanate daily.[21] It is worth noting that Wald

et al.[14] suggest 8 to 12 mg. per 100 cc. as a safe level of blood thiocyanate concentration. Elkins[23] calculates that the maintenance dose of thiocyanate used therapeutically in hypertensive patients[24] corresponds approximately to daily exposures encountered in industry equal to the maximum allowable concentration of hydrogen cyanide. In all reported cases of thiocyanate-therapy goiter, the goiter decreased in size when the thiocyanate was withdrawn or when thyroid was administered.

Goiters have been produced in animals with many substances, including cabbage, cyanide and thiocyanate salts.[25-28] Experimental study of such goiters has shown that the thiocyanate radical, by preventing the uptake of iodine, is responsible for this effect. Rawson et al.[18] described a thiocyanate goiter as "a hyperplasia of frustration," which may be prevented by iodine or controlled by thyroid therapy as a substitute. In such a hyperplasia, hypothyroidism is to be expected.

As suggested, these 2 cases are presented with the idea that continued exposure to cyanide in industry, even at low levels, can produce thiocyanate changes in the thyroid gland. The patient in Case 1 came from a known area of endemic goiter and was a cabbage, sauerkraut and cauliflower eater, so that several factors were operating in his case and may have been important in determining the character of the thyroid change when chronic industrial cyanide exposure added a third source of thiocyanate. Fühner[19] suggested that repeated rather than steady exposures are important in producing chronic symptoms. The course of illness in Case 1 supports the idea that the 1943 and 1946 hospital episodes were related to his return to cyanide exposure after sixteen years of freedom from symptoms in other jobs. Barker[16] has reported a case of rapid enlargement of a small thyroid adenoma present for many years after thiocyanate therapy. The time relation of the appearance of thyroid enlargement to the industrial cyanide exposure in Case 2 is striking. In this case, as in Case 1, more than the industrial factor was doubtless operating. It may be important that the sister of the patient in Case 2 had a colloid goiter.

Rawson, Hertz and Means[18] and Foulger and Rose[21] state that administration of sufficient iodine will prevent the development of thiocyanate goiters, or thyroid by mouth will relieve the enlargement if thiocyanate intake is continued. Such knowledge might prove an adjunct in the handling of thyroid enlargement in workers known to be exposed to hydrogen cyanide or cyanide salts. If constitutional symptoms, such as those present in Case 1, also occur, change in occupation is obviously required.

Summary

Two cases of thyroid change following occupational exposure to cyanide salts in the case-hardening industry are presented. In both cases, as might have been expected, more than occupational exposure to the cyanide radical was undoubtedly operating to produce thyroid disease, although such exposure may have been the decisive etiologic factor. It is suggested that the thiocyanate arising as a result of the body's ability to detoxify the cyanide radical by combination with sulfur-containing molecules, is responsible for the thyroid effects. In Case 1 many of the features of reported toxic manifestation of thiocyanates used in therapy of hypertension were present. This further suggests that previously reported cases of chronic cyanide poisoning in industry may in reality have been thiocyanate intoxication because of individual differences in excretion of the thiocyanate radical alone or with excessive cyanide exposure.

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EARLY NEUROLYSIS IN THE TREATMENT OF INJURY OF THE PERIPHERAL NERVES DUE TO FAULTY INJECTION OF ANTIBIOTICS*

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THE modern treatment of all types of infectious disease by repeated intramuscular administration of antibiotics has resulted in an increased incidence of injuries of the peripheral nerves due to improper injection into or adjacent to one of the major nerve trunks. Broadbent, Odom and Woodhall‡ suggest that in view of the established toxicity of the antibiotics in the central nervous system, this paralysis probably represents a specific peripheral neuritis due to a high local concentration of the agent. Late operative observations in 2 of their 4 patients indicated an intraneural lesion rather than an extraneural compression. All their 4 patients, 2 of whom were operated on, showed marked residual loss of function for as long as they were followed.

The purpose of this brief report is to describe sciatic-nerve injury following injection of antibiotics in the gluteal region in 2 children and to suggest that early radical neurolysis may offer the victims of this complication the best chance for maximum early recovery of function. In pediatric practice the physical possibility of faulty injection too near a major nerve trunk in an unco-operative, irritable infant is unusually great. The common practice of teaching nurses to plunge an intramuscular needle in to its full length with one quick stroke in order to minimize pain is decried, in passing, as unnecessary and hazardous.

The first of these patients showed paralysis of the common peroneal component of the sciatic nerve as a result of an intramuscular injection of penicillin and beeswax in oil, and the second an apparently complete sciatic paralysis caused by an injection of streptomycin. The first patient was treated conservatively with physiotherapy, corrective splinting, intermittent electric stimulation and careful observation for a period of twelve months. During this interval no return of function was discerned. Exploration of the nerve and neurolysis were then carried out. This was followed in two months by the first evidence of return of motor power, and continued slow improvement occurred during the next two years. At the present time the extremity is very useful, but there is still a residual deformity of the foot.

On the basis of this case and experience with early neurolysis after other types of peripheral-nerve injury, the second patient was subjected to very early exploration and radical neurolysis of the involved sciatic nerve — that is, within three weeks of the onset of paralysis. In this case substantial improvement in motor power was demonstrable within the first few weeks of operation, and progressed steadily so that at the end of thirteen months, an apparent 100 per cent functional return was evident without deformity.

CASE REPORTS

CASE 1. J. R. had impetigo and furunculosis at 1½ weeks of age treated at home by intramuscular injections of penicillin and beeswax in oil. After the last of these injections in January, 1947, it was noted that the baby held its left foot in internal rotation, and there was a foot drop. Neurologic examination showed apparent paralysis of all the dorsiflexors of the foot and toes and of the peroneal muscles. Sensation seemed normal. The gastrocnemius and other muscles supplied by the posterior tibial nerve contracted well. A diagnosis of paralysis of the common peroneal nerve secondary to a faulty injection of the antibiotic in the gluteal region was made.

The patient was followed throughout the first year of life with physiotherapy, corrective casts and frequent electric examination and stimulation. Twelve months after the injury there was no clinical evidence of return of function, but electric stimulation showed a minimal response of the peroneal muscles. Exploration of the left sciatic nerve was performed on January 27, 1948. The nerve appeared normal in the upper thigh, but at a level approximately 3 cm. proximal to the lower border of the gluteus maximus, the nerve was broadened, roughened, adherent to surrounding tissues and indurated to palpation for a distance of 1 to 1.5 cm. Direct faradic stimulation gave a response in the muscles supplied by the posterior tibial but not by the common peroneal component of the nerve. Thorough neurolysis of the involved area was carried out. There was no neuroma formation or evidence of division of any part of the nerve.

Physiotherapy and a night cast were resumed when the operative wound was healed. Two months after operation, the first clinical suggestion of contraction of the anterior tibial muscle was noted. In August (19 months after injury and 7 months after operation), there were good anterior tibial contractions, some dorsiflexion of the toes, but only very poor activity of the peroneal muscles. In October, 1949 (33 months after injury and 21 months after operation), there was no foot drop, and the child walked well. However, there was still a deformity of the fore foot with poor function of the peroneal musculature. Sensation always appeared intact within the limits of testing.

CASE 2. E. S., a 2-year-old girl, was admitted to the hospital on July 28, 1948, because of headache, stiffness of the neck and back, fever and vomiting of 2 days' duration, which had followed an upper respiratory infection of 10 days' duration. Physical examination revealed fever, dehydration, semistupor, opisthotonos, a rapid pulse, bilateral otitis media and hyperactive deep tendon reflexes. Lumbar puncture showed cloudy spinal fluid with no sugar, 12,000 white cells per cubic millimeter and pleomorphic bacilli on smear, which proved to be *Haemophilus influenzae*, Type B.

The patient was immediately given streptomycin (200,000 units every 2 hours) and sulfadiazine and was adequately hydrated. There was a very satisfactory clinical improvement within 24 hours, which continued. No organisms were seen or cultured from the spinal fluid after the 3rd day of treatment. The spinal-fluid white-cell count, which rose to 44,000

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‡Broadbent, T. R., Odom, G. L., and Woodhall, B. Peripheral nerve injuries from administration of penicillin: report of four clinical cases. *J. A. M. A.* 140:1008-1010, 1949.

per cubic millimeter (90 per cent polymorphonuclears) on the day after admission, fell abruptly to 600 on the 4th day and slowly thereafter to 75 within 10 days.

Three days after admission it was first noted that there was little spontaneous movement of the left leg. The patient was very difficult to examine at this time, and the possibility of a left hemiparesis was entertained. On the 10th hospital day she was seen in neurosurgical consultation and found to have a foot drop on the left, no reaction to plantar stimulation or pinprick below the knee, an absent ankle jerk with a normal knee jerk and a negative neurologic examination elsewhere. During the following 10 days her general condition continued to improve steadily. Repeated neurologic examination revealed a complete paralysis of the left sciatic nerve except that on one or two occasions slight flexion of the toes was noted. It was postulated that the paralysis was due to a faulty intramuscular injection of streptomycin in the gluteal region.

FIGURE 1. *Extent of Sciatic Nerve that Required Neurolysis Because of Reaction Following Faulty Intramuscular Injection of Streptomycin in Case 2.*

Exploration was recommended and carried out on August 29. A dense inflammatory and early fibrotic reaction was found involving the left sciatic nerve from its point of emergence at the lower margin of the piriformis muscle distally to the lower third of the thigh. After the nerve had been mobilized from the surrounding reaction it was apparent that the same type of fibrosis was present within the neurilemmal sheath itself. The sheath was therefore split longitudinally, and the peroneal and tibial components of the nerve separated. The sheaths around these separate bundles also appeared fibrotic, and they in turn were split longitudinally together with the sheath of the nerve to the short head of the biceps femoris (Fig. 1). All areas of constriction were divided in such a manner as to preserve the integrity of the axons. There was no purulent infection about the nerve, and cultures made at operation were negative. The nerve was intact anatomically. Faradic stimulation failed to produce contraction of any of the muscles supplied by the common peroneal or tibial nerves. Biopsy of the tissues from which the nerve was dissected was reported as follows:

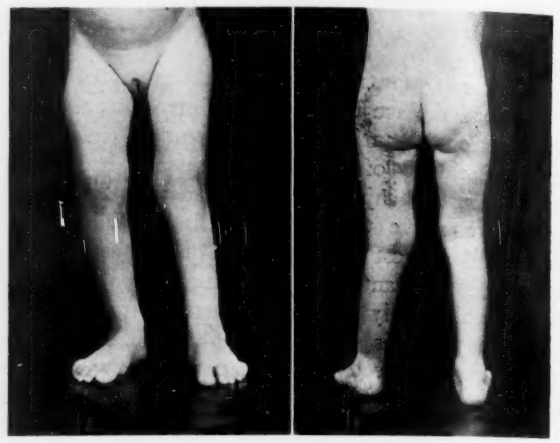

FIGURE 2. *Appearance of Patient in Case 2 Six Weeks after Injury and Nineteen Days after Neurolysis.*

There is paralysis of all muscles supplied by the left sciatic nerve except for beginning slight contractions in the toe flexors and gastrocnemius, and there is sensory impairment below the knee.

> There are areas of fibroblastic proliferation in which the cells are plump and form slight whorls and eddies. In other areas there are capillaries with perivascular infiltration of polymorphonuclear leukocytes. Among the fat cells there are many lipophages and histiocytes seen in some areas. The diagnosis is recent scar tissue with slight inflammation.

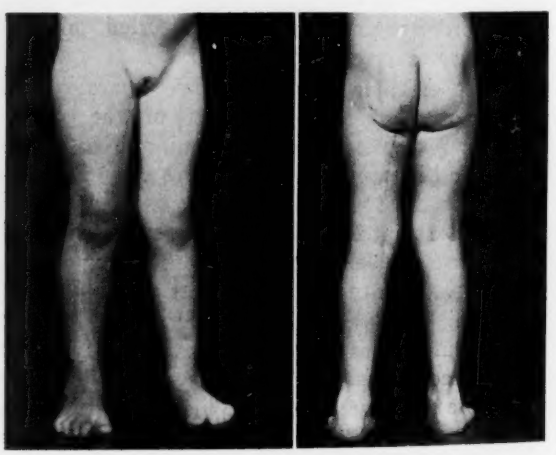

FIGURE 3. *Appearance of Patient in Case 2 Thirteen Months after Neurolysis.*

There is no measurable atrophy, no sensory loss and no demonstrable muscular weakness.

After operation, physiotherapy was begun as soon as the incision had healed, and a night cast was utilized to prevent foot drop. Examination at the time of discharge from

the hospital on the 19th postoperative day showed minimal but definite movement of the toe extensors and flexors and questionable slight contraction of the gastrocnemius muscle (Fig. 2).

Four months after operation, examination revealed contractions of all muscles supplied by the sciatic nerve; these were interpreted as poor to fair by the physiotherapists. Seven months after operation all sensation seemed to have returned, and examination showed good contraction of all muscles with the exception of the dorsiflexors of the toes, which were still described as only fair. In October, 1949 (13 months after operation) no atrophy was measurable, and muscle examination revealed no demonstrable weakness. The child walked, ran and played normally. The functional return approximated 100 per cent (Fig. 3).

Discussion

This communication is not presented as a well controlled clinical experiment. Rather, observations that proved to us quite striking and that are considered to be accurate, are described for general consideration.

It is well known that after traumatic nerve lesions with interruption of function but not of anatomic continuity, early exploration of the involved area with lysis of perineural and intraneural scarring is followed by return of function that is certainly accelerated in rate and probably increased in final extent as well. The experience of the 2 cases reported above suggests that recovery of peripheral-nerve function lost as a result of local reaction to an antibiotic injection is also facilitated by early extensive neurolysis. It is always a temptation to wait a little longer to see if recovery will begin to make its appearance spontaneously in this type of lesion. However, there is little or nothing to be lost by a careful early conservative exploration of the major nerve trunks, and there may be much to be gained.

Whether or not any given peripheral nerve will recover its function and at what rate and to what degree if early operative intervention is not carried out are questions impossible to answer. However, from the appearance of sciatic nerves in these 2 cases at operation, from the experience of other reported cases and from observation of traumatic lesions, the indications for early exploration seem definite. It is recommended, therefore, that in the face of this unfortunate complication of parenteral chemotherapy, if at the end of the period of acute inflammatory reaction — presumably two or three weeks — there is not progressive evidence of improvement in paralysis incident to a faulty intramuscular injection, exploration of the involved nerve accompanied by thorough neurolysis should be performed without further delay.

CHIPPED GLASS AS A PROBABLE CAUSE OF RETROPHARYNGEAL ABSCESS IN AN INFANT*

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THERE have been three reports describing the ingestion by infants of glass fragments from the rims of baby-food jars.[1-3] In the case reported below sudden hemoptysis developed while the patient was being fed from a glass jar that was found to have a chipped rim. A large retropharyngeal abscess developed.

Case Report

On June 30, 1947, N. F. (M.G.H.580110), a 10-month-old girl, was admitted to the Massachusetts General Hospital Emergency Ward with the complaint of hemoptysis and swelling in the neck. Two days prior to entry the baby had vomited some bright-red blood while the mother was feeding her from a commercial baby-soup jar. Shortly thereafter it was noted that a small piece of the jar rim was missing. The next day the child appeared feverish and refused to take any solid food. The mother observed that a swelling had developed on the left side of the neck. The infant's condition rapidly became worse, so that it was taken to the hospital.

Physical examination revealed a well developed infant in moderate respiratory distress. Respirations were snoring in quality, and the patient appeared to be tiring. The temperature was 104°F. by rectum. There was some reddening of the oropharynx. Direct laryngoscopy revealed a normal glottis, with an adequate airway. There was an inflamed, easily bleeding granular area 1 cm. in diameter involving the left pyriform sinus and extending up into the vallecula. Culture of the throat disclosed coagulase-positive hemolytic *Staphylococcus aureus* and *Escherichia coli*. A lateral x-ray film of the neck showed marked retropharyngeal swelling, with a large amount of air in this area.

The patient was transferred to a humidifying room in the Massachusetts Eye and Ear Infirmary. Intravenous injection of fluids and parenteral administration of penicillin were instituted. Eighteen hours after admission the temperature had risen to 105.8°F., and there was slight retraction of the chest cage. Sulfadiazine was added to the therapy. The child was taken to the operating room, where a curved hemostat was passed down the posterior pharyngeal wall until a point of maximum swelling was encountered to the left of the midline. This was punctured, with release of pus and, apparently, air under pressure. Suction was applied. After a moment of spasm normal respiratory rhythm returned. The respiratory obstruction that had been apparent before operation appeared relieved. Pus from the abscess grew out a pure culture of *Esch. coli*.

There was dramatic clinical improvement. The temperature dropped to normal on the 3rd hospital day. On the 4th hospital day fever returned, and streptomycin therapy was begun. Because of recurrent fever, dysphagia and persistence of x-ray findings (Fig. 1) the original incision was reopened

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on the 6th hospital day, with evacuation again of gas and pus. After this procedure there was steady clinical improvement (Fig. 2). The patient became quite normal and was discharged on the 20th hospital day.

No foreign body was ever located directly or by x-ray study. Examination of the baby-soup jar brought in by the mother revealed a two-pointed chipped defect in the rim 12 by 6 by 2 mm. in diameter.

Discussion

Since in this case the glass fragment was never located, absolute proof that it caused the abscess is lacking. However, circumstantial evidence is strong, and it seems appropriate to point out the danger of such foreign bodies.

Figure 1. *Lateral X-Ray Film of the Neck Taken on the Sixth Hospital Day, Showing Retropharyngeal Swelling.*
There appears to be a large, gas-filled cavity in this area, indicated by the arrow.

Ingested fragments of glass may not always make themselves known by causing bleeding from the throat or esophagus. In the infant with peritonitis reported by Hyde,[2] the etiology of the disease was unknown until a glass fragment was discovered at rectal examination. It therefore appears worth while, in cases of retropharyngeal abscess, mediastinitis or peritonitis in infants, to question parents carefully concerning the possibility of glass ingestion and to have them examine the rims of recently used baby-food jars.

As suggested by Leopold,[3] it is important for the mother to realize that force should be exerted at more than one point about the rim on opening of such glass containers and to inspect carefully the opened jar for chipped areas. If the manufacturer were to coat the rim of such jars with a thin layer of white plastic material, broken places might be made more easily visible.

Summary

A case of retropharyngeal abscess (*Escherichia coli*) in an infant is reported, apparently due to ingestion of a piece of glass from a baby-soup jar. There was dysphagia, respiratory obstruction and high fever. Two operative decompressions of the abscess, chemotherapy and parenteral administration of fluids permitted a favorable outcome. The prevention of such accidents is discussed.

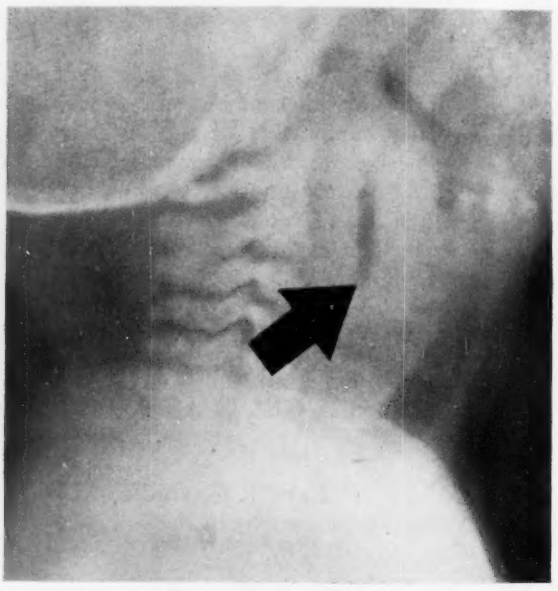

Figure 2. *Lateral X-Ray Film of the Neck Taken on the Ninth Hospital Day.*
There is a marked decrease in the size of the gas-filled cavity.

We are indebted to Dr. A. S. MacMillan for interpretation of the x-ray films, to Miss A. B. Mangiaracine for culturing and identifying the organisms found and to Dr. Allan M. Butler for helpful suggestions.

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INTESTINAL OBSTRUCTION DURING PREGNANCY

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INTESTINAL obstruction is a rare complication of pregnancy. It occurs from the same cause and demands the same surgical attention that is given to the nonpregnant person. However, it is more difficult to make an early diagnosis and to perform intestinal operation in the presence of an enlarged, gravid uterus. The infrequent appearance and grave prognosis of this condition warrant the reporting of the following case.

CASE REPORT

Mrs. C. B., a 24-year-old primigravida whose menstrual periods had occurred every 28 days and lasted 4 days, without dysmenorrhea, had had no previous operations. Her last menstrual period had begun on April 10, 1949. The pregnancy had been completely uneventful for 8 months. On the evening of December 5, she experienced a constant, dull pain in the region of the umbilicus. She had two loose stools, and vomited after eating. On the following day, the pain and vomiting continued, and she was hospitalized. She did not appear to be particularly ill.

Physical examination revealed a normal 8 months' pregnancy. There was an occasional mild uterine contraction. There was no intestinal distention and no spasm or rigidity of the abdominal muscles.

The temperature was 98.6°F., the pulse 86, and the blood pressure 118/76.

Examination of the blood showed a white-cell count of 12,500, with 76 per cent neutrophils.

A small amount of gas was expelled with an enema. The patient was given glucose solution intravenously and sedated with Sodium Amytal. After 24 hours she was able to tolerate liquids by mouth. Four days later she was retaining a regular diet and was asymptomatic except for a mild dull pain in the region of the umbilicus. She was discharged from the hospital, with a probable diagnosis of gastroenteritis.

On the following day, she was nauseated and vomited frequently in copious amounts. She was readmitted to the hospital. The pain about the umbilicus had subsided. The temperature was 98.8°F., and the pulse was 92. There was no visible intestinal distention. No abnormal masses could be palpated. There was no spasm or rigidity of the abdominal muscles. Slight tenderness could be elicited in the right upper quadrant. The white-cell count was 6050, with 70 per cent neutrophils. The urine was normal except for an occasional granular cast in the sediment. A single large scout film of the abdomen, taken with the patient lying supine, did not reveal an excessive amount of gas in the intestinal tract. An enema was given, with a small amount of gas and liquid fecal results. Continuous Wangensteen suction and adequate intravenous therapy were maintained.

Within 24 hours of admission, the patient began to assume an anxious expression. She complained of pain in the right upper quadrant and lower back. The pulse had gradually increased to 128. There were no local physical findings. At this time, a rectal examination revealed the cervix to be effaced and dilated 2 cm. The fetal head was well engaged. Because of the ideal conditions for induction of labor, it was decided to terminate the pregnancy, in the hope that this would not only help to clarify the diagnosis but also eliminate the handicap of the enlarged uterus, if intestinal operation was necessary. The possibility of a partial volvulus or intussusception, which might correct itself, was also considered. Therefore, the membranes were ruptured, and 10 hours later a 5½ pound boy was delivered under local anesthesia. During labor, intravenous therapy and Wangensteen suction were continued.

After the uterus had been emptied, the diagnosis of intestinal obstruction became very obvious. The patient complained of intermittent pain, and borborygmi could be heard at the height of the colic. A definite elastic mass, 10 cm. in diameter, could be palpated in the right upper quadrant. Distended loops of intestine and visible peristalsis were evident.

A laparotomy was performed by Dr. George Blood. The abdomen was entered through a right-rectus-muscle incision at the level of the umbilicus. There was a large amount of free brown fluid in the peritoneal cavity. The jejunum was twisted on its mesentery for approximately 244 cm., causing obstruction and partial strangulation. This mass of bowel was delivered through the incision, and the torsion was relieved. The involved intestines were covered with hot wet sponges, and observed for 10 minutes. At this time, examination revealed a narrow ring in the intestine at the site of torsion, which showed no signs of circulatory recovery. It was excised and a lateral anastomosis was performed. Aside from a febrile reaction of 102°F. on the 3rd and 4th postoperative days, the patient made an uneventful recovery. She was discharged from the hospital 11 days after operation.

DISCUSSION

The jejunum is a rare site for a volvulus. Its essential cause is an abnormally mobile segment with inadequate fixation of the mesentery. Overfilling and gaseous distention, as a result of the enlarged uterus, may have been an etiologic factor in the case reported above. The torsion of the jejunum probably increased gradually to its final stage of about 360°. This, and the presence of the overlying gravid uterus, could account for the late appearance of the local physical findings and could also explain why the involved intestines were in good condition, except for the necrotic ring at the site of torsion, despite the fact that seven days had elapsed from the beginning of the patient's illness to the time of operation.

Early diagnosis and early operation of intestinal obstruction are particularly essential during pregnancy. However, the differential diagnosis between this complication and various other conditions, such as appendicitis, pyelitis, renal colic, and gastroenteritis, is not always easy. For the first five days of this patient's illness, there were no physical signs or laboratory data to support a diagnosis of intestinal obstruction. The enlarged, gravid uterus completely masked the usual abdominal findings. A lack of local physical findings in a patient with abdominal pain, nausea and vomiting, should make one suspicious of the presence of intestinal obstruction.

The need for conservative operative treatment in the handling of this complication is well known. It was fortunate, in the case reported, that conditions

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were so ideal for induction of labor. Otherwise, one would have had to perform the necessary intestinal operation with the handicap of an enlarged uterus. Bettman and Immerman* successfully resected 91 cm. of gangrenous bowel in a two-stage operation, twenty-four hours intervening. A week later, labor began spontaneously, and the patient was delivered by forceps. In certain cases, a cesarean section might have to be included in the surgical procedure to obtain sufficient exposure of the site of obstruction, despite the added risk of sepsis.

*Bettman, R. B., and Immerman, S. W. Acute intestinal obstruction complicating pregnancy: intestinal resection and recovery. *J. A. M. A.* 90:384, 1928.

MEDICAL PROGRESS

BODY-FLUID PHYSIOLOGY: THE ROLE OF POTASSIUM IN CLINICAL DISTURBANCES OF BODY WATER AND ELECTROLYTE*

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FIVE years ago the studies on tissue composition were summarized, and an attempt was made to relate changes in tissue composition to clinical disturbances in the balance of water and electrolyte.[1] It was pointed out that sodium is known to be present in variable amounts in the cells and that shifts of sodium from extracellular to intracellular fluids and vice versa affect the acid-base equilibrium of blood. Furthermore, the amount of potassium in the cells is also variable, and cellular potassium usually varies inversely with intracellular sodium in muscles. Evidence was brought out that the composition of the cells leads to changes in extracellular fluids and that changes in extracellular fluids alter the electrolyte content of cells. It was concluded that the changes in tissue composition must be taken into account in the planning of fluid therapy and that potassium, as well as sodium, chloride and water, is indicated in many conditions. Since the publication of this paper, these concepts have been elaborated in experimental studies and suitable observations of patients. The present review considers recent developments in this field, especially with reference to potassium. It is pointed out below that recent work provides a firm foundation for the new point of view and clinical experience has developed a modification of fluid therapy that is safe and strikingly more effective in appropriate cases.

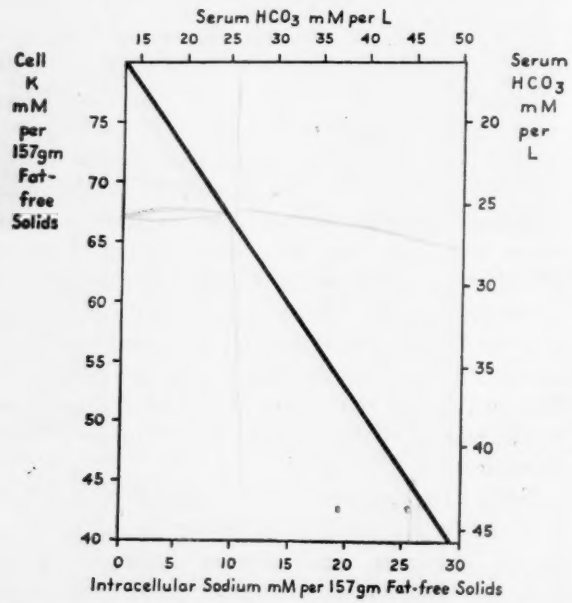
Serum HCO3 mM per L
15 20 25 30 35 40 45 50
Cell K mM per 157gm Fat-free Solids
75 70 65 60 55 50 45 40
Serum HCO3 mM per L
20 25 30 35 40 45
0 5 10 15 20 25 30
Intracellular Sodium mM per 157gm Fat-free Solids

FIGURE 1. *Relation of the Serum Bicarbonate Concentration to the Intracellular Sodium and Potassium per 157 gm. of Fat-Free Solids of Rat Muscle.*

This amount of fat-free solids is associated with 450 cc. of intracellular water and is therefore about the same amount of intracellular water as is present in 1 kg. of tissue. The line shows the relation of intracellular sodium to potassium. The bicarbonate concentrations on the ordinate are the best fit for the potassium values, and the bicarbonate concentrations on the abscissa are the best fit for the intracellular sodium values.

Analyses of the serum and muscles of rats have shown that, under certain circumstances, the concentration of bicarbonate in serum varies directly with intracellular sodium and inversely with potassium.[2] The experimental conditions involved renal adjustment over several days to three weeks in the presence of a deficit of one of the ions, sodium, potassium or chloride. One group of rats was subjected to metabolic acidosis resulting from loss of body sodium, another to metabolic alkalosis produced by loss of chloride, and still another to primary deficit of potassium either as a result of a diet low in potassium or as a result of repeated injections of desoxycorticosterone acetate while on a normal diet. The rats deprived of sodium or chloride were fed diets deficient in sodium or chloride respectively. The relation between the concentration of bicarbonate in serum and intracellular sodium and potassium per unit of fat-free solids of rat muscle is shown in Figure 1. Attention is directed to the fact that the relation was demonstrated not only when the primary change was extracellular in metabolic acidosis and alkalosis but also when the primary change was loss of intracellular potassium. Evidence is thereby given that the acid-base equilibrium of extracellular fluids changes cellular composition and changes in the intracellular composition produce alterations in the acid-base equilibrium of extra-

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cellular fluids. The relation may be regarded as a biologic equilibrium or adjustment. It must be regarded as a biologic adjustment, since a chemical equilibrium or steady state would require only a few hours instead of days. The paper discusses the clinical implications of these findings.

As pointed out below, the relation applies to human beings. Muntwyler and his associates[3] confirmed the findings in rats, but, although potassium deficiency causes the same change in the cells, alkalosis is not readily produced in dogs.

It is now clear that changes in the acid-base equilibrium involve alterations in intracellular as well as extracellular fluids. The normal reaction of the blood cannot be maintained without a suitable relation between the body contents of sodium, potassium, chloride and water. Although other factors such as the buffers and the balance of phosphate are involved, the body content of sodium, potassium, chloride and water describes the main features for many purposes. If the circulation and renal functions are adequate, some sort of adjustment will be achieved, particularly if sufficient water is available. However, at present, it is not possible to define the relation between the acid-base equilibrium and tissue composition when multiple disturbances involving body water, sodium, potassium and chloride occur. It is certain that the serum bicarbonate concentration does not predict the intracellular composition under these conditions. However, a deficit of one of the ions, sodium, potassium or chloride will tend to reach the adjustment shown in Figure 1 if sufficient water and the other ions are available and circulatory and renal functions permit adequate renal excretion.

Most cases of acidosis involve deficits of water, sodium, potassium and chloride. In the dehydration of infantile diarrhea[4, 5] the deficits are about 9 millimols of sodium, 9 millimols of chloride, 10 millimols of potassium and 100 gm. of water per kilogram of body weight. Since the losses of sodium and chloride are about equivalent, the acidosis is explained by the transfer of sodium to the cells owing to deficit of potassium. The relative deficit of sodium in extracellular fluids is therefore the result of losses of potassium. The changes in tissue composition in diabetic acidosis are apparently similar.[6-12] In the case of an eight-year-old girl with severe diabetic acidosis, Pratt and I found the retentions during recovery to be 100 gm. of water, 12 millimols of sodium, 8 millimols of chloride and 6 millimols of potassium per kilogram of body weight. The acidosis can be explained by the relative deficit of potassium together with accumulation of ketone acids. Other types of acute acidosis are probably similar and involve losses of potassium as well as sodium chloride and water.[13, 14]

Relatively pure deficit of sodium is apparently rare as a cause of acidosis in patients. However, feeding of a certain kind of protein milk produces acidosis owing to retention of chloride without sodium.[15-17] Balances indicate that practically all the intracellular sodium is transferred to the extracellular fluids. Acidifying salts such as ammonium and calcium chloride probably produce similar changes in tissue composition. In the one infant subjected to feeding with protein milk longer than four days, there was evidence of loss of potassium from the cells during the final days. Future studies may demonstrate that acidosis due to primary deficit of sodium tends first to lead to relative deficiency of sodium in the extracellular and intracellular fluids and only later to losses of potassium. One would anticipate that, at one stage of the events, the deficit of potassium would bring about a transfer of sodium back into the cells and thereby aggravate the acidosis, particularly if water deficits develop. This concept fits in with the renal excretion in response to ammonium chloride acidosis.[13, 14]

This type of reaction apparently took place in Case 4 of a previous study.[5] This patient suffered from severe diarrhea, which had been treated at home with a diet that contained too little water for a baby with diarrhea and to which sodium chloride had been added. In the hospital, at the beginning of the study, the concentration of bicarbonate in serum was very low and that of chloride was very high. Recovery occurred with the retention of water and potassium but no increase in body sodium or chloride. On entry into the hospital, the acidosis is explained by the transfer of sodium into the intracellular fluids owing to a deficit of potassium and water. The administration of sodium chloride before the study began had prevented the deficit of these ions from developing; the persistent diarrhea had prevented the restoration of body potassium, and the deficiency of water had prevented the renal adjustment to deficit of potassium. This type of response is probably frequent when acidosis is treated with physiologic saline solution and insufficient water that is free of electrolyte.

In cases of acidosis due to deficits of sodium, potassium, chloride and water, the intracellular sodium is apparently high or normal but probably not as high for a given deficit of potassium as the relation of intracellular sodium to potassium shown at biologic adjustment in Figure 1. In some cases of chronic nephritis deficits of potassium develop.[18] It is probable that some of these patients will have acidosis that has been aggravated at one stage by the transfer of sodium from the extracellular fluids to the cells. This type of acidosis would be dependent on the relative deficits of both sodium and potassium, but owing to the disturbances in renal function it might persist without deficit of water.[19]

The actual deficits of electrolyte in alkalosis have not been determined precisely in patients. As a result of vomiting and loss of gastric juice, animals do not show a deficit of potassium unless abundant water is available.[20] In infants recovering from alkalosis due to pyloric stenosis low concentrations of potassium develop in serum when no potassium is

given. When potassium is given, there is evidence of transfer of potassium to the cells.[21] Unpublished balance studies in 4 infants with alkalosis caused by hypertrophic pyloric stenosis gave evidence of high intracellular sodium in all cases but appreciable deficits of potassium in only 2. Apparently, some vomiting patients will not get sufficient water to permit the renal adjustment to loss of chloride. Others get enough water to lead to losses of potassium as well as chloride. It is not known whether administration of large amounts of sodium bicarbonate as in the Sippy treatment of peptic ulcer leads to loss of potassium as well as alkalosis. The experimental studies indicate that such patients may have a deficit of both chloride and potassium.*

Suitable observations have not been made to bring out the changes in intracellular composition accompanying compensated respiratory acidosis and alkalosis. If the changes shown in Figure 1 are dependent on blood pH, the changes in cellular composition should be in the opposite direction from that of the chart. If the changes are the result of the concentration of bicarbonate in serum, the changes should resemble those of the chart.

The occurrence of alkalosis as a result of deficit of potassium is well established in a number of conditions. The most clear cut examples are those of patients with Cushing's syndrome in whom low serum chloride and potassium and high bicarbonate develop. This alkalosis is refractory to sodium chloride and ammonium chloride but responds to potassium salts.[22-24] The most frequent disturbance of this type is found in patients who are subjected to postoperative suction. The initial alkalosis is dependent on the loss of chloride, but the administration of salt solution permits the kidneys to excrete potassium. Within a day or so, the serum bicarbonate remains high, and the serum chloride low, despite abundant available sodium chloride. At this time the concentration of potassium in serum is low, and the nonprotein nitrogen may be high. The patients become weak and may show paralysis. They are nauseated and distended and have poor intestinal tone and motility. There is likely to be edema and perhaps frank signs of cardiac failure and respiratory difficulty. After the administration of potassium as well as sodium chloride, the symptoms improve, and the normal electrolyte concentrations in the serum are restored.[25-27] The restoration of serum bicarbonate concentration requires the retention of as much as 6 millimols of potassium per kilogram of body weight in some cases and takes place rapidly after about six days of potassium therapy.[28]

In some patients, high bicarbonate, low chloride and low potassium develop after extensive operations when losses of gastrointestinal secretions are negligible.[29] It is assumed that in these patients the trauma of the operations provoked an adrenocortical response through the hypophysis (ACTH). Indeed the injection of ACTH or Cortisone may induce deficit of potassium and alkalosis.[30, 31] Elkinton, in a personal communication, described a psychotic patient with high bicarbonate, low chloride and low potassium in serum that must be classified as alkalosis dependent on potassium deficit. The patient was extremely undernourished, but although he had been taking little food for four weeks, there was no history of vomiting or diarrhea. The patient retained about 15 millimols of potassium per kilogram of body weight and excreted an almost equivalent amount of sodium during recovery. Fashena[32] gave a similar report on a seven-month-old Negro boy, who showed persistent alkalosis and failed to excrete an alkaline urine even when abundant sodium chloride was available. There were no data on potassium balance. The renal function returned to normal after the nutrition had improved. Although cats fasted for one week show no fundamental change in the electrolyte composition of muscle, these clinical observations suggest that undernutrition after operations, infections and severe illnesses occasionally lead to losses of body potassium and alkalosis. The adrenal glands may play a role in promoting excretion of potassium in these patients.[29, 30]

Animals fed diets low in potassium fail to grow at a normal rate; their hair tends to fall out, and they are weak and listless.[33, 34] After several weeks, the hearts show myocardial necrosis. Heart lesions may be produced in four days by diets low in potassium and high in sodium chloride together with injections of desoxycorticosterone acetate.[35, 36] Rats on food low in potassium are likely to have loose stools, which have been shown to contain more chloride than sodium.[37] The diarrhea responds to the addition of small amounts of potassium to the food. In extreme potassium deficiency, the intestines become greatly distended, and no stools are passed. The animals seem to die from paralytic ileus.[38] Some animals show frank paralysis responding to potassium.[39] Kidney lesions have also been recognized in potassium deficiency.[33]

The same symptoms have been described in patients with potassium deficiency. Poor muscle tone, weakness and paralysis have been encountered in periodic familial paralysis,[40] after treatment of diabetic coma[6-8, 10] and cholera,[41] in postoperative hypokaliemic states[26-28] and sprue.[42] The paralysis is apparently dependent on the effect of low serum potassium on the myoneural junction. Cardiac dilatation, changes in the electrocardiogram and myocardial necrosis have been observed in patients receiving repeated injections of desoxycorticosterone acetate.[43, 44] Similar changes occur in conditions accompanied by potassium deficiency.[9, 28, 45, 46] Myocardial failure, enlargement of the liver, pulmonary edema and generalized edema are frequent in hypokaliemic states, and these symptoms improve with potassium therapy or when food is taken.[27, 28] Vomiting, abdominal distention and perhaps paralytic ileus are also observed. In addi-

tion, some patients show edema associated with low serum albumin. The injection of plasma proteins and amino acids fails to restore the serum proteins, but improvement follows potassium therapy.[28] The beneficial effect is so striking that one gets the impression that the production of serum albumin is more adequate in tissues with normal potassium. However, the effect is probably indirect through improvement in the appetite and nutrition.

It has not been established in patients that depletion of body potassium leads to diarrheal stools containing more chloride than sodium. A number of years ago, Dr. Fuller Albright observed a young woman with refractory alkalosis and watery stools containing more chloride than sodium. The observation was not published. Similar cases should be sought since it is likely that they will show potassium deficit, and the intestinal disturbance may improve after potassium therapy.

Gamble and his associates[47] and Darrow[48] described 2 cases of refractory alkalosis and watery stools containing more chloride than sodium. The disturbance seemed to depend on a congenital defect in intestinal absorption. Although the symptoms improved with potassium administration, the defect in absorption persisted. It is likely that potassium deficit was a result of the disturbance in intestinal absorption in these patients rather than a cause of the intestinal disorder.

The production of potassium deficiency is dependent on greater output than intake. It should be understood that deficiency of potassium refers to greater loss of potassium than other cellular constituents. If potassium and nitrogen are excreted in the proportions found in the cells, the remaining tissues may have essentially normal composition. This causes serious undernutrition but not deficiency of potassium. Since the kidneys and stools always contain potassium, diets low in potassium result in deficiency of this ion. In experimental animals it is difficult to produce deficiency of muscle potassium on diets that are low in both potassium and sodium chloride. Since most food contains adequate amounts of potassium, parenteral feeding is the chief means of nutrition that is likely to cause deficiency in patients. The tendency is aggravated by the fact that infusions of sodium chloride solutions increase the excretion of potassium partly by an effect on the kidneys but also owing to replacement of potassium by sodium in the cells.[49] On a normal diet the excretion of potassium by the kidneys is increased by injections of desoxycorticosterone acetate, by Cortisone, and by adrenocorticotrophic hormone (ACTH). Conditions leading to activation of the adrenal glands by ACTH have a similar effect. However, evidence that this occurs regularly in conditions thought to be dependent on the "alarm reaction" has not been obtained. Potassium excretion by the kidneys is increased by injections of sodium bicarbonate and lactate and alkalosis owing to deficit of chloride if sufficient water is available.[2, 50, 51] Increase in the concentration of potassium in plasma leads to losses in the urine. If the rise in potassium concentration is due to increased intake, a deficit should not be produced. However, because of internal shifts the concentration of potassium in serum may rise and lead to excretion causing cellular deficits. This type of reaction may occur in shock and anoxia, which lead to replacement of potassium by sodium in cells.[52-54] In normal subjects glycosuria does not cause increased urinary excretion of potassium. However, during the development of diabetic acidosis large amounts are excreted.[55] This loss is probably dependent on release of potassium by the cells when carbohydrate metabolism breaks down. Elevations in the concentrations in serum produced by injections of sodium chloride release potassium from the cells and cause increased excretion.[56] Some patients with renal insufficiency are unable to conserve potassium.[18] This tendency is probably aggravated by large intakes of sodium chloride. Although excessive losses in the stools are the chief factor leading to deficit of potassium in diarrhea, low intakes and internal shifts accompanying the circulatory disturbances play a role. Since gastric juice contains about 15 millimols of potassium per liter, losses from this source are appreciable, but the deficit seems ultimately to depend on increased urinary excretion. Intestinal juices contain potassium at about the same concentrations as serum.

Engel, Martin and Taylor[46] observed patients with low concentrations of both calcium and potassium in serum. When the concentrations of potassium were raised, symptoms of tetany became manifest. When the concentrations of potassium remained low, symptoms of tetany did not occur despite levels of calcium usually associated with tetany. These investigations demonstrated that certain electrocardiographic changes that have previously been attributed to decreases in calcium concentration were associated with low levels of potassium in these patients.

Although the amount of electrolyte per unit of fat-free solids may be low, tissue analyses indicate that it is unlikely that increase in potassium within the cells occurs except during water deficiency or states accompanied by high concentrations of potassium in serum.[57, 58] When rats are given a diet high in potassium, muscle composition remains normal. If they are given water containing potassium chloride at greater concentrations than can be excreted by the kidneys, they refuse to drink. If rats receive intraperitoneal injections of potassium chloride, the serum concentration rises according to the amount administered. Accompanying the rise in the serum, there is an increase in cellular potassium. However, if they survive about twelve hours, compensatory excretion leads to low normal potassium in the muscles. As shown by these observations, high intracellular potassium

is unlikely to develop from high intakes unless they lead to high serum concentrations. This is unlikely to occur without renal or circulatory failure.

If the concentration of sodium in serum rises owing either to deficiency of water or to injections of hypertonic saline solutions, water is shifted from the intracellular to the extracellular fluids. This leads to an increase in intracellular electrolyte per unit of wet weight but not per unit of fat-free solids. This type of change in tissue composition is essentially intracellular deficit of water and not excess of electrolyte. I therefore believe that increase in cell potassium is only encountered in the true sense when extracellular concentrations of potassium rise.

Adrenal metaplasia in babies and children is accompanied in many cases not only by virilism but also by a disturbance in electrolyte metabolism. The kidneys excrete abnormal amounts of sodium and chloride, resulting in extremely low concentrations of sodium and chloride in serum, high concentrations of potassium and symptoms resembling Addisonian crisis. Even if the body sodium is kept relatively normal by large intakes of sodium chloride, the concentration of potassium in serum may remain as high as 7 to 8 millimols per liter for long periods. When desoxycorticosterone acetate is given, the urinary losses of sodium are overcome but the serum potassium remains high. The disturbance does not seem to be a true adrenal insufficiency since there is little evidence of a disorder of carbohydrate metabolism leading to low blood sugars. Furthermore, they withstand the low concentrations of sodium much better than patients in whom the adrenal glands have been destroyed. The renal disturbance behaves as if some steroid of the abnormal adrenal cells blocked the usual effect of adrenal hormones on the kidneys or some abnormal steroid were produced that has an unusual effect on renal function.[59-61] The changes in tissue composition that accompany this chronic elevation of the concentration of potassium in serum are not known. In the untreated patients, there are no striking disturbances in circulatory functions except those explained by the loss of sodium. However, when desoxycorticosterone was given to 1 patient I observed cardiac dilatation and circulatory failure despite no evidence of loss of potassium. This conclusion is supported not only by normal or high concentrations of potassium in serum during survival but also by normal composition of the muscle at autopsy. The electrocardiograms showed high T waves accompanying the elevation of serum potassium, but no arrhythmia.

(To be concluded)

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CASE RECORDS OF THE MASSACHUSETTS GENERAL HOSPITAL

Weekly Clinicopathological Exercises

FOUNDED BY RICHARD C. CABOT

TRACY B. MALLORY, M.D., *Editor*

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CASE 36251

PRESENTATION OF CASE

A twenty-three-year-old married laboratory worker was admitted to the hospital complaining of abdominal cramps.

Two days before admission the patient began to have lower abdominal cramps comparable to menstrual cramps, which progressively increased in severity and frequency. The night before admission they occurred every five minutes and prevented her from sleeping. She had no nausea, vomiting or vaginal bleeding. She had always had regular menstrual periods, occurring every twenty-eight days, lasting five days and usually accompanied by moderately severe cramps. The last menstrual period had begun forty-five days before admission, and there had been no bleeding or spotting since that time. She had noticed no swelling or tenderness of the breasts and no urinary symptoms.

Nine months before admission the patient had seen her physician because of a few small nodules in the left breast. These had been present for about two years and were considered by him to be of no significance. At the same time pelvic examination revealed a small irregularity on the posterior surface of a retroverted uterus, well above the uterosacral ligaments and believed to be an adherent ovary with endometriosis. The uterus was movable and nontender; proctoscopic examination for a distance of 15 cm. was negative.

Physical examination on admission revealed a rather pale, well developed, well nourished woman in no acute distress. The lungs were clear. There was minimal generalized lower abdominal tenderness. On pelvic and rectal examination an exquisitely tender, round mass could be palpated between the cervix and the rectum; the uterine fundus could not be identified. The mass was approximately 6 cm. in diameter, tensely cystic in consistence and somewhat movable, with pain.

The temperature was 99.2°F., the pulse 90, and the respirations 20. The blood pressure was 105 systolic, 60 diastolic.

Examination of the blood disclosed a white-cell count of 17,400, with 85 per cent neutrophils. The red cells showed moderate variation in size and shape. Examination of the urinary sediment was negative.

An operation was performed on the afternoon of admission.

DIFFERENTIAL DIAGNOSIS

DR. JUDSON A. SMITH*: The past history is of some interest in that nine months before admission

*Obstetrician, Massachusetts General Hospital.

the patient had a pelvic examination at which the uterus was found to be retroverted and there was a suspicion of endometriosis.

The first significant fact in the present illness is that the menstrual period was seventeen days late. In a young married woman who has always had regular periods this is presumptive evidence of pregnancy, and I think it would be safer to regard this patient as pregnant until we can prove that she was not.

The patient complained of acute pelvic pain and had an exquisitely tender pelvic mass, a little fever and a high white-cell count. The most obvious diagnosis that suggests itself to me is an ectopic pregnancy. Is there anything against an ectopic pregnancy? There are a few minor points that might arouse a little suspicion of this diagnosis — the location of the mass, for instance. In an ectopic pregnancy, the mass usually is more on one side or the other of the pelvis, but of course it could be behind the uterus if the tube or the ovary was adherent to the uterus, or if the pregnancy was cornual. It is, I think, unusual for a cornual pregnancy to provoke symptoms as early in pregnancy as this, and furthermore, as a rule, a cornual pregnancy produces symptoms by rupturing and the rupture is accompanied by much more severe shock than this patient had. The total lack of bleeding is also against an ectopic pregnancy. It is true that ectopic pregnancies can go on for weeks without any bleeding. However when anything happens to the ovum and the implantation is interfered with, when tubal abortion begins or the sac ruptures, there is usually quite promptly some bleeding from the endometrium. The uterine cramps, of course, were quite consistent with a beginning tubal abortion, but it seems a little surprising that after two days of abdominal pain there was absolutely no uterine bleeding. Patients with a tubal pregnancy who begin to have symptoms are likely to have persistent pelvic pain and distress, and I am a little surprised that, if this patient was having a tubal abortion, she was not in more distress than she appeared to be. Also, she had very little abdominal tenderness, which is a little surprising. However, none of these things rule out tubal pregnancy — not even all of them together.

There is one very disturbing fact, and that is that the physicians were unable to identify the uterine fundus. That complicates the reasoning about the case considerably because when the fundus is unidentified and a pelvic mass is found located as this mass was, the suspicion arises whether the mass is not in reality the fundus. This mass was apparently the size of the fundus, and it felt round and tensely cystic, which is perhaps an adequate description of a pregnant uterus. If the mass was in fact uterine fundus, is that an argument against ectopic pregnancy? It is not necessarily so because the patient could have had a tubal pregnancy behind the fundus and pressure on the fundus would produce exquisite tenderness. The mass was a little bit large for an ectopic pregnancy as early as this although it is possible. It happens every once in a while that a patient who has all the symptoms of an ectopic pregnancy, is found at operation to have an ectopic pregnancy, but the mass is found to be due to some other condition — for example, an ovarian cyst.

Why was the fundus not felt? Ordinarily, the fundus is quite easy to feel, especially if it is a little bit pregnant. A retroverted fundus is sometimes missed because the patient is tender, and one cannot get deep enough into the abdomen to pick up the fundus. It can be very difficult to feel if there is abdominal tenderness and spasm, but there was not in this case. The fundus can be missed, of course, if there is a large mass in the pelvis of which the uterus is a part, such as fibroids or abscess. In this case there was no large mass. The mass was exactly in the center between the cervix and the rectum — right where a retroverted fundus ought to be. The patient was not excessively obese, and it is very difficult to see why the fundus could not be felt. The more one thinks about it, the more one suspects that what was felt back of the cervix was really a retroverted fundus.

Another diagnosis that will occur to one at once is a strangulated ovarian cyst with a normal uterine pregnancy. Strangulated cysts in pregnancy are usually on one side or the other, but of course they can drop down into the cul-de-sac. I do not think as a rule strangulated cysts produce cramp-like pain, but I could explain it by assuming that she was beginning to abort and that the uterus was contracting. If she had a strangulated cyst, it seems a little peculiar that there was not more distress than is described and more definite abdominal tenderness, but the greatest point about ovarian cyst is the question of where the fundus was. If the palpable mass was the fundus, how could an ovarian cyst have occurred there? If she had an ovarian cyst occupying that space, the fundus could not occupy it but would be sticking up in front and would be still more difficult to miss. We will have to pass that diagnosis as not probable.

What else could this have been? Could it have been fibroids of the uterus? If a fibroid occupied the cul-de-sac, again, where was the fundus? It ought to have been forward and even more conspicuous. Fibroids in a pregnant uterus will give rise to these symptoms, they will produce severe pelvic pain, — not necessarily cramp-like, — they will sometimes become exquisitely tender, and they will produce a little fever and a leukocytosis. Fibroids can present very much this picture, but they very rarely cause it as early in pregnancy as this. I do not recall ever having seen a patient two weeks over her period (and I have seen many of them at that stage with

fibroids) who had as acute symptoms as this — later in pregnancy, but not this early.

Could this have been entirely due to endometriosis? Could this attack have been one of the typical episodes that occur in endometriosis? I think that is quite unlikely because the acute attacks of pain in endometriosis are due to bleeding into the endometrioma. The bleeding is subject to the same controls as normal menstruation and occurs at the time of menstruation; this woman, we assume, was pregnant and therefore she would not bleed into an endometrioma. Of course she might not have been pregnant. She might accidentally have missed a period and perhaps had a severe attack of endometriosis. I think it is highly improbable, however, that she would have been so sick, with acute pelvic pain due solely to endometriosis.

Could this have been an abscess? I think it is impossible because there was no evidence of previous pelvic infection, and the lesion was too discrete — was described as definitely round, smooth and slightly movable. Abscesses are not usually movable and do not usually feel round and centrally located. The more I think about it, the more I am suspicious that the examiners were feeling a retroverted and retroflexed pregnant uterus. Of course if the uterus was not pregnant, it is a little hard to see why it was described as feeling tensely cystic. The uterus does not generally feel that way.

Perhaps I could account for all the symptoms without introducing any disease other than pregnancy. Suppose the patient had nothing but a retroverted pregnant uterus. Is there any way to explain the symptoms on that basis? I might suppose that there was a beginning abortion, or an attempt to produce an abortion. I think I can rule out any mechanical interference with the pregnancy because there had been no external bleeding. I cannot rule out any attempt by the use of various ergot preparations that are sold and used for that purpose. They give rise to severe pain and cramps. However, one thing very much against a beginning abortion is that the patient had not bled externally although the severe cramps had been going on for two or three days. Occasionally, a woman will begin abortion with two or three days of cramps, but it is most unusual. Most abortions begin with bleeding and terminate with cramps; if the cramps come first, they are promptly followed by bleeding. I think a beginning abortion is not a very probable explanation for this.

Finally, there is one very remote possibility that might not occur to anybody but an obstetrician, and that is that the patient did not have anything but a normal pregnancy in a retroverted uterus. I have seen patients — not always even with a retroverted uterus — who early in their pregnancy complain of quite severe crampy pelvic pain and who on examination present such exquisite tenderness that it is hard to be certain that there is not an ectopic pregnancy. Usually, in these cases there is some spurious element in the picture that makes one suspect that the pregnancy is normal, but these cases are extremely confusing and such patients have been operated upon. I have done it myself, and I believe everybody who has done extensive pelvic or abdominal surgery has at some time or other felt compelled to operate upon a woman for an ectopic or a strangulated cyst and found that she had nothing but a normal pregnancy. There is one procedure that should always be done, and that is an examination under anesthesia, which will sometimes exclude such diagnoses as cysts and ectopic pregnancies and thus avoid an unnecessary laparotomy.

On the basis of the information that we have here I should think that the only reasonable diagnosis is ectopic pregnancy or possibly an intrauterine pregnancy with a retroverted uterus adherent or not adherent and with or without an endometriosis.

Dr. F. Dennette Adams: Could the fever and the white-cell count have been on the basis of a normal pregnancy?

Dr. Smith: I do not know that we can explain the fever and the white-cell count on the basis of a normal pregnancy. The temperature was only 99°F. The white-cell count was 17,000, which is a little high to explain on the basis of a normal pregnancy. Later in pregnancy the white-cell count is elevated, but it is seldom elevated as much as 17,000.

A Physician: Was there any evidence of blood loss in this patient?

Dr. John Graham: I saw this patient first about nine months before she came into the hospital. At that time the pelvic findings were as follows: "cervix anterior, fundus in third-degree retroversion, fundal protrusion into the rectum, with a question of a mass on it, as a round structure, 2 or 3 cm. in diameter, protruding into the rectum. The fundus seems fixed back there." The findings by rectal examination I have in my notes: "question of excessive polypoid or other tissue on the posterior wall of the rectum or attached to the uterus." Because of these findings I asked Dr. Ulfelder to see the patient. The other things I think it fair for Dr. Smith to know are that this patient was anxious to have a baby, not to have an abortion, that she was a very good patient from the point of view of standing pain and that my impression as I saw her very early on the morning of admission was that she was in very severe pain, which was definitely cramp-like to begin with. It settled down into steady pain with increased waves of pain.

Regarding the question of the abnormal blood cells, when I first saw the patient, she had a mild macrocytic anemia of unexplained origin, with a red-cell count of 3,500,000 and a hemoglobin of about 11 gm. I was interested in the anemia because the patient had worked with radioactive isotopes and there was some question whether or

not she had had more exposure to these isotopes than she should have had, but that question could never be decided. The anemia disappeared under the administration of a better diet and iron.

Dr. Howard Ulfelder: When I saw this patient nine months before this admission, I confirmed Dr. Graham's findings of an irregularity on the posterior surface of the uterus, and that was why I considered the possibility of an adherent ovary with endometriosis but did not regard it as definite enough to warrant anything more than further observation. Proctoscopic examination was negative. Examination under anesthesia after the patient was admitted added nothing to what is described in the record. The fundus could still not be palpated. She still had a round mass, which could be moved quite easily and moved with the cervix. It was my opinion that this was not just a pregnant retroverted uterus.

Clinical Diagnosis

? Twisted ovarian cyst.
? Normal pregnancy.

Dr. Smith's Diagnosis

Ectopic pregnancy; ?normal pregnancy with retroverted uterus.

Anatomical Diagnoses

Leiomyoma of uterus with red degeneration.
(*Pregnancy.*)

Pathological Discussion

Dr. Ulfelder: I explored this patient. When I first opened the peritoneum I was afraid I had stumbled onto another complication of pregnancy, and that was a ruptured appendix, because there was quite a large amount of cloudy fluid coming up out of the pelvis. However, on inspection the appendix appeared to be completely normal. In the pelvis, I found an enlarged uterus, which was stretched out and distorted by a mass in its posterior wall. This mass was definitely part of the uterus and quite separate from the adnexa. Both tubes were normal. The left ovary contained a corpus luteum of pregnancy, about 2.5 cm. in diameter, and the right ovary was normal. The posterior surface of this mass was ulcerated, and gelatinous material was exuding from it into the peritoneal cavity. It was my opinion that the mass was a fibroid that had undergone rapid degeneration and ulceration, and therefore I did a myomectomy. Dr. Castleman, who sectioned the resected specimen and confirmed my impression that it was an encapsulated mass, probably a fibroid, said that he would prefer not to attempt to decide by frozen section the question of a leiomyosarcoma. We closed the uterine wall and closed the abdomen.

Dr. Tracy B. Mallory: The tumor was a leiomyoma of the uterus showing the so-called red degeneration that characteristically occurs in pregnancy, although, as Dr. Smith mentioned, it is usually not present at so early a stage. The microscopical appearance is essentially that of infarction of the tumor although it is rare to find any reason why the infarction should occur. Occasionally this type of degeneration of fibroid tumors does occur in nonpregnant uteruses, but it is much more common under the strain of pregnancy.

CASE 36252

Presentation of Case

First admission. A thirty-six-year-old woman was admitted to the hospital because of abdominal swelling.

Approximately a year before admission the patient had noted the insidious onset of progressive abdominal enlargement. For two months prior to entry she had complained of increasing distention, with moderate "gas" pains. There had been no change in bowel habit, catamenia or urinary function. Except for weakness, easy fatigability and suspected weight loss, a review of the systems was negative.

Physical examination showed the heart and lungs to be clear. A large, movable, cystic mass extended upward from the pelvis, almost filling the abdomen. An irregular, tender mass was palpable in the right lower quadrant. On pelvic examination the uterus and adnexa could not be felt. The cervix was normal, but there was a round, smooth, tender mass 2 cm. in diameter palpable in the posterior cul-de-sac.

The temperature was 99°F., the pulse 100, and the respirations 20. The blood pressure was 135 systolic, 70 diastolic.

Laboratory findings were all within normal limits. A chest film was normal. X-ray films of the abdomen disclosed a round pelvic mass consistent with ovarian cyst, ascites and multiple calculi in the left kidney, with evidence of localized pyelonephritis. Peritoneoscopy showed bilateral cystic ovarian lesions, with no evidence of peritoneal implantation. On the eleventh hospital day a radical hysterectomy, bilateral salpingo-oophorectomy, omentectomy and appendectomy were performed. Both ovaries were the site of a papillary cystadenocarcinoma, more marked on the right. One liter of ascitic fluid was present, and the omentum and pelvic peritoneum were studded with metastases. A few granular lesions on the small-bowel mesentery suggested lymphatic invasion. Postoperative recovery was uneventful, and she was discharged much improved sixteen days later.

Second admission (three years and ten months later). Over a one-month period immediately fol-

lowing discharge she received a total of 3000 r of x-ray therapy through anterior and posterior abdominal portals. Her general health remained excellent, she gained weight, and frequent examinations showed no evidence of recurrent tumor during the year and a half in which she continued to attend the Out Patient Clinic. Since the last Out Patient visit she had remained well except for a mild, ill defined digestive complaint, constipation requiring frequent enemas and a dull left-lower-quadrant pain after being on her feet all day. Six hours prior to the second admission the patient noted the sudden onset of severe left-upper-quadrant pain radiating through to the back just to the left of the spine. The pain was continuous and associated with nausea and copious vomiting of dark-green material. There were no further gastrointestinal complaints. Symptoms referable to the pulmonary, cardiovascular and genitourinary systems were denied.

Physical examination revealed the patient to be obese, anxious, hyperpneic and acutely ill. The chest was clear. The heart was negative except for bigeminal rhythm attributed to the febrile illness. There was mild abdominal distention, with tenderness extending from the left costal margin to the iliac crest and laterally into the left flank. Vague tenderness of less intensity was present on the right side. Mild muscular spasm and rebound tenderness were demonstrated on the left. A mass in the left loin was felt by some observers and was interpreted as kidney. There was minimal left-costovertebral-angle tenderness. Peristalsis was present and of normal pitch. Tenderness high up on both sides was noted on rectal examination. Pelvic examination showed no evidence of recurrent tumor and was considered negative.

The temperature was 101°F., the pulse 130, and the respirations 25. The blood pressure was 138 systolic, 78 diastolic.

The specific gravity of the urine was 1.005, and an occasional erythrocyte and 4 leukocytes per high-power field were present in the sediment. A smear of the segment showed no organisms, and culture of the urine grew a few colon bacilli. The hemoglobin was 12.8 gm., and the white-cell count 16,700. The nonprotein nitrogen was 18 mg., and the total protein 6.1 gm. per 100 cc. The chloride was 95 milliequiv., the sodium 134.7 milliequiv., and the potassium 3.7 milliequiv. per liter, and the calcium 8.6 mg., the phosphorus 2.5 mg., the alkaline phosphatase 3.5 units, and the serum amylase 35 units per 100 cc.; the prothrombin time was 48 per cent of normal. An electrocardiogram was normal. An x-ray film of the abdomen failed to outline either kidney definitely, although one observer believed the left-kidney shadow was enlarged. Several calcific densities were noted in the left renal region. A calcific shadow most closely resembling a phlebolith was seen in the left pelvis. A pyelogram was unsatisfactory. Chest x-ray films showed elevation of the diaphragm, atelectasis of both lung bases and a shadow suggesting an infarct in the right-lower-lung field. Barium-enema examination was negative except for a granular appearance of the colon attributed either to residual mineral oil or polyposis.

During the first forty-eight hours in the hospital the patient became progressively worse. The temperature rose to 103°F., with a proportionate rise in pulse and respirations. The abdominal pain, tenderness and distention became somewhat worse, and previously positive physical findings were slightly intensified. One observer's note was as follows:

> The patient is tender over the entire left flank, with spasm of the left lateral muscles. Tenderness is present over the tip of the eleventh and twelfth ribs down to the anterior superior iliac crest and extending laterally from this. There is slight abdominal distention, with active normal peristalsis. There is no psoas sign.

The leukocyte count rose to 21,000, with 90 per cent neutrophils. A catheterized specimen of urine contained 5 to 10 leukocytes and 10 to 20 erythrocytes per high-power field, and a granular cast was seen.

An operation was performed on the second hospital day.

Differential Diagnosis

Dr. Lamar Soutter*: We have here a woman with the sudden onset of signs and symptoms of a severe infection and a background of carcinoma with metastases.

May we see the x-ray films, Dr. Wyman?

Dr. Stanley M. Wyman: These films all were taken at the time of the second admission. There is a negative Graham test that is not noted in the record. The lung fields themselves appear clear on admission, but two days later there is some elevation of both leaves of the diaphragm, with linear density in the lower-lung fields, which although consistent with atelectasis may possibly represent infarctions. The pyelogram shows some diminution in function, the contrast substance being less dense than usual. The left kidney is poorly outlined, but I think it can be seen and it appears somewhat larger than the right. The calcified shadows described are well seen, and in a film taken forty-five minutes after the injection of the contrast substance, these calcifications are seen to lie in the region of the left minor calyxes. The left urinary passages show some changes consistent with localized pyelonephritis in and about these calcifications. The ureter itself does not seem abnormal. The right urinary passages are not remarkable. The barium-enema examination done the same day shows the

*Assistant surgeon, Massachusetts General Hospital.

descending colon to lie further laterally than usual, suggesting that it is being pushed outward by the kidney. No definite intrinsic disease is present in the colon, but the right colon was not adequately examined. There is an unusual loop of gas-filled bowel in the upper midabdomen that conforms quite closely to the expected site of the duodenal loop. The gas-filled shadow ends over the spine. The loop looks wide. I do not see any evidence of intrinsic bone disease.

DR. SOUTTER: We are faced with an analysis of the infection that this patient showed on the basis of the findings. A number of things come to mind; the first is the perforation of a hollow viscus. Could this woman have had a perforation of the stomach, the small bowel or the colon with either a peritonitis or a localized abscess? She had active peristalsis throughout the hospital stay, and on admission she did not have evidence of a dilated loop of bowel or of tenderness over the abdomen although she did have some tenderness bilaterally on rectal examination. I think it is fairly safe to assume that she did not have a generalized peritonitis. Could an ulcer of the stomach have perforated into the lesser peritoneal sac, with dissecting infection downward on the left side? That would be somewhat unusual. One would expect the maximal tenderness to be in the upper abdomen and the patient to have been more acutely ill on admission. Could this have been a localized diverticulitis of the colon, with rupture and abscess on the left side? That would explain the tenderness and a good deal of the spasm on the left if the abscess were well walled off. It would not exclude the presence of peristalsis. However, with a diverticulitis of that degree, one would expect to see on barium-enema examination spasm in the colon in the region of the acute inflammatory process. Rupture of the small bowel would be very rare and without general peritonitis would be most unusual. I think that probably a rupture of any of these organs is unlikely.

Could the patient have had acute infection in the biliary tract? I think the lack of localizing symptoms on the right, particularly in the presence of so much fever and leukocytosis, makes an acute cholecystitis very unlikely. An acute pancreatitis will cause tenderness and spasm on the left side but usually not as marked as this. The serum amylase was normal. One usually expects to find an elevated blood amylase early in the course of acute pancreatitis. However, there have been many cases of acute pancreatitis without any evidence of an elevated blood amylase, and in some the elevation is very transitory so that the normal chemical values do not help us to exclude or include the diagnosis of pancreatic disease. Could this have been pancreatitis with fat necrosis? That usually starts with mild fever, which increases. Usually, the abdominal pain, tenderness and spasm are more generalized but more marked in the upper abdomen as compared with the lower abdomen. The localization of the tenderness and spasm to the left side makes me think that acute pancreatitis is unlikely.

On the x-ray film some dilatation of the duodenum is demonstrated, suggesting an obstruction in the region of the ligament of Treitz and introducing another factor that I had not previously considered. Was there an interference with the circulation of the bowel or spleen? Splenic infarcts occasionally occur, and are accompanied by tenderness and spasm in the region where this patient had tenderness and spasm. They are usually not accompanied by such violent symptoms as she had, and the fever usually subsides as the process becomes less acute. I think that splenic infarction would be quite unlikely under these circumstances. Could the patient have had an infarction of the mesentery of the small or large bowel? There are several reasons why she did not. The first point against it is her age; it is usually a disease of old people. The second thing that is against it is the fact that the patient continued to have active peristalsis despite increasing symptoms of infection during the period of hospitalization. This would make me opposed to a diagnosis of mesenteric thrombosis.

The kidney problem is an interesting one, as is the problem of the previous carcinoma of the ovary. We know cystadenocarcinomas of the ovary — even without metastases — are not readily susceptible to cure by surgical extirpation. However, there are a few cases reported in the literature in which, after the primary tumor has been removed, there was a regression and an apparent arrest of the disease. This woman went nearly four years without getting into trouble, but the carcinoma could have recurred insidiously at any time; the site of recurrence would not necessarily have been in the pelvis. We note that the pelvic examination did not suggest any local recurrence. The increasing atelectasis of the lungs and elevation of the diaphragm suggest increased intra-abdominal pressure. We did not have evidence of dilated stomach or bowel, which could have caused that elevation. The elevation, however, could have been caused by an increasing accumulation of fluid in the peritoneal cavity — either ascitic or on the basis of peritonitis.

Could there have been an infection of the kidney based on obstruction? Most acute kidney infections do not produce vomiting early in the course of the disease, but obstruction due to a stone very often causes vomiting. I think it is fair to say that there was a chronic infection in the left kidney. There was evidence of it on the first admission and further evidence on the second admission. There was not sufficient evidence that it was the entire cause of the fever. Could this patient have had two different lesions, partial obstruction in the duodenum due to

the recurrence of the carcinoma in that area and also an acute abscess around the left kidney? I think these diagnoses are a possibility.

Could there have been a primary tumor of the left kidney superimposed upon the previous infection? That remains a possibility despite the lack of kidney symptoms prior to entry and the lack of hematuria. Renal-cell carcinoma can occur without any of these. The patient had the picture of infection and some upper gastrointestinal obstruction, and I think it would be safe to assume that she had infection around the left kidney, probably a pyelitis or nephrolithiasis and possibly a perinephritic abscess, that she had a recurrence of disease in the peritoneal cavity, probably with some ascites, and that this caused some obstruction of the duodenum.

DR. WYMAN: The type of calcification in the kidney makes me think of tuberculosis. Dr. Soutter, do you think that is important?

DR. SOUTTER: That had not occurred to me in this case but I think it is worthy of comment. It is a possibility. The acuteness of the episode without dysuria and without a prolonged history is a little against tuberculosis. Most of the people that I have seen with tuberculosis of the kidney have had considerable dysuria associated with it.

DR. F. DENNETTE ADAMS: If she had a stone in the pelvis of the kidney, could that not have caused ureteral obstruction even though it did not show on x-ray examination farther down?

DR. SOUTTER: It certainly could. There was not an obvious stone in the pelvis of the kidney, however, and I therefore believe that a stone was probably not the cause of the difficulty in this case. An obstructive lesion in the kidney often produces left-upper-quadrant pain radiating to the back, with vomiting.

DR. SAUL M. MARCUS: I think it is very difficult to rule out perinephritic abscess in this case. I recall a case of an eighty-five-year-old man with carcinoma of the prostate and obstruction in the renal artery who had symptoms very similar to these. We did find a perinephritic abscess at autopsy. In this case I think one should consider perinephritis very seriously.

CLINICAL DIAGNOSIS

Perinephritic abscess, left.

DR. SOUTTER'S DIAGNOSES

Chronic pyelonephritis, with nephrolithiasis of left kidney.
Perinephritic abscess, left.
Metastatic papillary cystadenocarcinoma of ovary, with subacute duodenal obstruction.

ANATOMICAL DIAGNOSIS

Carbuncle of kidney.
Nephrolithiasis.

PATHOLOGICAL DISCUSSION

DR. TRACY B. MALLORY: The patient was explored with a preoperative diagnosis of perinephritic abscess. The perinephritic fat was extensively infected, but incision through it disclosed no abscess until the kidney itself was exposed. This was more than twice the size of a normal kidney and showed multiple abscesses scattered beneath the capsule. At one point the abscesses were so close together that a large area of necrosis had developed, and the lesion resembled what is commonly called a carbuncle of the kidney. It was decided that the lesions were much too extensive to be drained, and therefore the kidney, with a considerable portion of the perinephritic fat, was resected. There were multiple stones scattered through all the calyxes. We could not find any tuberculosis. The exploration naturally did not show what was in the peritoneal cavity. We cannot answer the question whether there was a recurrence of carcinoma.

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PARADOX OF THE PARADOXICAL PULSE

By common consent, the term paradoxical pulse, or "pulsus paradoxus," is considered to refer to a phenomenon in which the peripheral pulse is markedly diminished, or even abolished, during ordinary or quiet inspiration; it promptly reappears during expiration. It can best be detected by the use of a sphygmomanometer, the cuff being inflated to a point that is 5 or 10 mm. less than the systolic blood pressure. Careful auscultation over the upper forearm then discloses whether or not the pulse is diminished or abolished during inspiration. Small variations should be ignored.

For many clinicians the term paradoxical pulse suggests a phenomenon that is elicitable with difficulty, confusing in its implications and impossible to explain. Students, who are taught that it is diagnostic of constrictive pericarditis or pericardial effusion, somehow arrive at a vague belief that the phenomenon actually represents a reversal of the normal response of the pulse to the phases of respiration. Hence the adjective paradoxical, one of the definitions (Webster) of which is: "(referring to) any phenomenon or action with seemingly contradictory qualities or phases." So far, then, all seems to be in order, and there may be little point in belaboring such an ancient and established clinical concept. Those who have accepted the prevailing explanation for the phenomenon will, however, be surprised to find that the explanation usually offered is entirely erroneous and that, in actual fact, the paradoxical pulse is not paradoxical at all.

It was the celebrated Kussmaul,[1] who, in 1873, first suggested that the phenomenon be termed paradoxical, " . . . partly because of the striking disproportion between the action of the heart and the arterial pulse, and partly because the pulse, although apparently irregular, shows in reality a regular waxing and waning." He said nothing about a reversal of the normal response of the pulse to the phases of respiration. This notion, which has gradually become very widespread, is said[2] to have originated with Klemensiewicz.

Modern investigators have finally provided the measurements necessary for an understanding of the effect of respiration on hemodynamics and, in so doing, have shown that Klemensiewicz's theory is untenable. Lauson, Bloomfield and Cournand,[3] using precise technics for measuring pressures in the right side of the heart, great veins, pulmonary artery, femoral artery and intrapleural space, have shown in normal persons that during "rhythmic breathing of moderately increased depth," there is a decrease in systemic systolic pressure, probably attributable to a temporary decrease in the output of the left ventricle. This, in turn, is thought to be due to an expansion during inspiration of the pulmonary vascular bed so that the amount of blood actually reaching the left ventricle is momentarily decreased. Be this as it may, the fact is established once and for all that in the normal person the systemic systolic pressure either remains constant or is decreased, not increased, during inspiration. Forceful inspiration invariably causes a decrease

in systemic systolic pressure and hence may produce a typical "paradoxical" effect even in normal persons.

It is clear, therefore, that the paradoxical pulse is merely an exaggeration of the normal response of the pulse to inspiratory and expiratory changes in intrapleural pressure. The true paradoxical pulse, which occurs during ordinary quiet breathing, is not as specific in its diagnostic implications as was formerly supposed. It occurs not only in cases of constrictive pericarditis and pericardial effusion but also in patients with pronounced pulmonary emphysema, severe asthma, massive pleural effusion or pneumothorax, and even in some patients with cardiac decompensation. This fact does not diminish its diagnostic usefulness to the clinician but does require considerable caution in the interpretation of the phenomenon.

One may conclude, therefore, that the paradoxical pulse is paradoxical only in the sense intended by Kussmaul and that it is not specifically diagnostic of pericardial effusion or constrictive pericarditis. There seems to be no very good reason to abandon the term, especially since no better one comes readily to mind, but the characterization of the phenomenon as the reversal of fanciful "normal" physiologic relations should be abandoned.

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NATIONAL COMMITTEE FOR EDUCATION ON ALCOHOLISM

Since the first of this year the National Committee for Education on Alcoholism has functioned separately from the Yale Plan on Alcoholism, of which it had been a division for five years. The affairs of the Committee are now directed from its national headquarters in New York City. The connection between the Committee and the Yale Plan was severed for various reasons, among them being administrative difficulties occasioned by separate offices in New York City and New Haven, financial handicaps owing to the mistaken belief that donations to the Committee automatically included contributions to the University and, finally, the fact that the authorities at Yale rightly considered the administration of a national program of health and welfare to be the function of an independent national organization rather than a department of the University, which, although it will continue to cooperate with the Committee in every way possible, is primarily concerned with research, scientific publications and university education.

A widely representative board of directors, consisting of professional and social leaders of national prominence, will direct the activities of the Committee. Mrs. Marty Mann continues as executive director, and Yvelin Gardner as associate director. Those interested in the work of the Committee are confident that the progress made in conjunction with the Yale Plan will be continued and that success will eventually attend the nation-wide effort to solve one of the serious social problems of contemporary America.

SUPERSONIC SURGERY

The progress of man, almost from time immemorial, has been marked by his success in converting large rocks into little ones. From the days of Sumer and before, this activity has found its final outlet in the building of roads and of temples and the boring of tunnels and in other major results of extravesical lithotrity. The conventional, penitential rock piles on which those unfortunate members of society who have been duly deprived of liberty and the pursuit of happiness are forced to labor stand like cairns along the path of enlightened penology.

But man's mind and hand cannot be stayed by his veneration for ancient customs and methods, and certain scientists at Yale, according to the News Bureau of that university, convinced that all gall must be divided into at least three parts, have announced a new technic for breaking gallstones by the application to them of high-frequency sound waves. The principle employed is that of the imaginary violinist who by striking an impossible note

on a theoretical instrument may cause an Empire State building to crumble like the walls of Jericho.

In the first experiments at Yale human gallstones were placed in water in a cellophane bag and subjected to a 400-kilocycle ultrasonic beam. This energy, transmitted through the water, fissured or fragmented the gallstones. In the next experiment similar stones were placed first in exteriorized loops of rabbit intestines, then in the gall bladder of a dog, and the current was turned on. These efforts met with equal success, after which, presumably, silence fell and healed the blows of sound. To paraphrase a familiar line of verse, perhaps unfairly, it seems to be a matter of break, break, break these cold gray stones, incredibly high C.

No doubt many human volunteers whose stones, at least, are not silent will eagerly await the opportunity of benefiting from this discovery.

WALTER P. BOWERS MEMORIAL

In an editorial published on February 3, 1949, the *Journal* called attention to the building needs of the Clinton Hospital. This hospital, originally founded by Dr. Walter P. Bowers, editor of the *Journal* from 1921 to 1937, had embarked on a campaign to raise funds for a new building. Dr. Bowers, as president of the hospital, had initiated this campaign in 1944, although he was then nearly ninety years of age, and on his death in 1947 left $100,000 — the bulk of his estate — to the project.

The work prospered, and on May 21, 1950, the new 75-bed Walter P. Bowers Memorial Building, comprising the main part of the Clinton Hospital, was opened for public inspection and the reception of patients.

Among the passengers by the barque Eagle, which arrived here last week from Newfoundland, was a man named Michael Mulloy, at the advanced age of one hundred and three years. He enjoys fine health, and says he never lost a night's rest from sickness in his life. He walks with firm step, and can see to read the finest print without the aid of glasses.

Boston M. & S. J., *June 19, 1850*

MASSACHUSETTS MEDICAL SOCIETY

WOMAN'S AUXILIARY

At the annual meeting of the Woman's Auxiliary to the Massachusetts Medical Society, held on May 16, 1950, the following officers were elected: president, Mrs. Howard F. Root (Suffolk), 44 Dwight Street, Brookline; president-elect, Mrs. William G. LeBrecht (Worcester North), 181 Highland Avenue, Leominster; first vice-president, Mrs. John B. Hall (Norfolk), 17 Lane Park, Boston; second vice-president, Mrs. C. Stoyle Baker (Middlesex North), 15 Holyrood Avenue, Lowell; recording secretary, Mrs. George E. McCabe, 77-3 Park Avenue, Worcester; corresponding secretary, Mrs. Carleton S. Bullard (Essex North), 476 Merrimac Street, Newburyport; and treasurer, Mrs. Roger I. Lee (Suffolk) (second term), 446 Walnut Street, Brookline.

The officers elected by the district auxiliaries are as follows: Barnstable, president, Mrs. Oscar S. Simpson (Centerville), vice-president, Mrs. Sheldon B. Hunt (Yarmouthport), secretary, Mrs. Robert D. Watt (Hyannis), and treasurer, Mrs. Lee Britton (South Yarmouth); Bristol North, president, Mrs. Joseph V. Chatigny, vice-president, Mrs. Milton Johnson, secretary, Mrs. Samuel Poplack, and treasurer, Mrs. C. Nason Burden; Essex North, president, Mrs. Lucien Chaput, first vice-president, Mrs. Lincoln C. Peirce, second vice-president, Mrs. John R. McDermott, recording secretary, Mrs. Frank DeCesare, corresponding secretary, Mrs. Herbert Horne, and treasurer, Mrs. Joseph Levek; Essex South, president, Mrs. James A. Dumas (Lynn), first vice-president, Mrs. David Dove (Beverly), second vice-president, Mrs. Thomas R. O'Brien (Lynn), recording secretary, Mrs. Lawrence Ross (Annisquam), corresponding secretary, Mrs. Charles F. Deering (Danvers), treasurer, Mrs. H. Gregory Alexander (Salem), and assistant treasurer, Mrs. Stilman G. Davis, Jr. (Salem); Hampden, president, Mrs. James A. Seaman,

vice-president, Mrs. Martin Gaynor, secretary, Mrs. James Visconti, corresponding secretary, Mrs. William Donoghue, and treasurer, Mrs. H. H. Shuman; Hampshire, president, Mrs. J. H. F. Longpre, vice-president, Mrs. Thomas F. Kenny, secretary, Mrs. David B. Jennison, and treasurer, Mrs. Henry A. Tadgell; Middlesex East, president, Mrs. Jost Michelsen (Winchester), vice-president, Mrs. Thomas Devlin (Stoneham), recording secretary, Mrs. Sigmund Szydlowski (Wakefield), treasurer, Mrs. John Anderson (Stoneham) and corresponding secretary, Mrs. Thomas Hearne (Melrose); Middlesex South, president, Mrs. Harold P. Giddings (West Newton), vice-president, Mrs. Joseph Merriam (Framingham), recording secretary, Mrs. Harold Brown (Newton Center), corresponding secretary, Mrs. George Guy Bailey (Belmont), assistant corresponding secretary, Mrs. David H. Reid (Waltham), and treasurer, Mrs. Gordon Saunders; Middlesex North, president, Mrs. George L. Duggan, vice-president, Mrs. J. Bradley Varnum, recording secretary, Mrs. Herbert Abrams, corresponding secretary, Mrs. Raoul L. Drapeau, and treasurer, Mrs. Samuel A. Dibbins; Norfolk, president, Mrs. David L. Lionberger, president-elect, Mrs. Newton C. Browder, vice-president, Mrs. Gerald L. Doherty, treasurer, Mrs. Knowles B. Lawrence, corresponding secretary, Mrs. Harold N. McKinney, and recording secretary, Mrs. E. Louis Friederman; Plymouth, president, Mrs. John Angley (Bryantville), vice-president, Mrs. Leon Alley (Lakeville), secretary, Mrs. Alton Hurlburt (East Bridgewater), and treasurer, Mrs. Samuel Gale (Brockton); Suffolk, president, Mrs. Roger I. Lee, president-elect, Mrs. A. J. A. Campbell, recording secretary, Mrs. J. Martin Woodall, corresponding secretary, Mrs. Henry Robey, treasurer, Mrs. Oscar Raeder, and directors, Mrs. Harvey Kelley (one year), Mrs. T. H. Lanman (two years) and Mrs. M. C. Sosman (three years); Worcester, president, Mrs. Bancroft C. Wheeler, president-elect, Mrs. James C. McCann, vice-president, Mrs. Chester W. Brown, recording secretary, Mrs. H. H. Serunian, corresponding secretary, Mrs. Francis M. Pare, and treasurer, Mrs. Hyman Heller; Worcester North, president, Mrs. William G. LeBrecht (second term), first vice-president, Mrs. Arthur G. Heininger, second vice-president, Mrs. Joseph McLean, recording secretary, Mrs. Robert H. Goldman, corresponding secretary, Mrs. Jesse C. Hales, and treasurer, Mrs. John J. Curley.

DEATH

JONES — Robert L. Jones, M.D., of Chelmsford, died on May 14. He was in his sixty-seventh year.

Dr. Jones received his degree from Jefferson Medical College of Philadelphia in 1910. He was secretary-treasurer of the Lowell Medical Club and a fellow of the American Medical Association.

His widow, a son and a daughter survive.

MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH

CONSULTATION CLINICS FOR CRIPPLED CHILDREN IN MASSACHUSETTS

The July and August schedule for Consultation Clinics for Crippled Children in Massachusetts under the provisions of the Social Security Act follows:

Orthopedic Clinics	Date	Clinic Consultant
Haverhill	July 5	William T. Green
Salem	July 10	Paul W. Hugenberger
Gardner	July 11	Carter R. Rowe
Brockton	July 13	George W. Van Gorder
Springfield	July 18	Garry deN. Hough, Jr.
Pittsfield	July 19	Frank A. Slowick
Worcester	July 21	John W. O'Meara
Fall River	July 24	David S. Grice
Hyannis	July 27	Paul L. Norton
Greenfield	August 3	Charles L. Sturdevant
Lowell	August 4	Albert H. Brewster
Gardner	August 8	Carter R. Rowe

Rheumatic Fever Clinics	Dates
North Reading	July 11, 18, 25
Fitchburg	July 5, 12, 19, 26

Plastic Clinics	Consultant
Eastern Massachusetts	Bradford Cannon
	Semi-monthly
Western Massachusetts	Joseph M. Baker
	Monthly

Physicians referring new patients to clinics should get in touch with the district health officer to make appointments. Patients are seen by appointment only.

BOOKS RECEIVED

The receipt of the following books is acknowledged, and this listing must be regarded as a sufficient return for the courtesy of the sender. Books that appear to be of particular interest will be reviewed as space permits. Additional information in regard to all listed books will be gladly furnished on request.

Resuscitation and Anesthesia for Wounded Men: The management of traumatic shock. By Henry K. Beecher, A.M., M.D., Henry I. Dorr Professor of Research in Anesthesia, Harvard Medical School, and chief, Department of Anesthesia, Massachusetts General Hospital. 8°, cloth, 161 pp., with 28 plates and 32 tables. Springfield, Illinois: Charles C Thomas, 1949. $5.50.

The author has based his text on his military experience in the war, but his observations and technics may well be applied to similar conditions in peace times. The work is divided into four parts: the wounded man — his mental and physical state; physiologic derangements in the wounded found on forward hospital admission; treatment of wounded men; and anesthesia for the wounded. The text is well written, and the monograph well published. It should be in all medical libraries.

Skin Grafting. By James B. Brown, M.D., professor of clinical surgery, Washington University School of Medicine, and chief of plastic surgery, Veterans Administration; and Frank McDowell, M.D., assistant professor of clinical surgery, Washington University School of Medicine, St. Louis. Second edition. 4°, cloth, 339 pp., with 239 illustrations. Philadelphia: J. B. Lippincott Company, 1949. $7.50.

The first edition of this book was entitled *Skin Grafting of Burns.* This second edition has been enlarged and broadened in scope. Material on the repair of lesions resulting from trauma and from excessive radiation has been added. The early care of trauma is outlined, since it may influence the

success of subsequent skin grafting. All the procedures described have been used by the authors. New illustrations have been included, and there is a good bibliography on burns and on skin grafting. The publishing is excellent, and the book should prove useful to surgeons.

The Practice of Urology. By Harry C. Rolnick, M.D. 2 vol. 4°, cloth, Vol. I, 616 pp., Vol. II, 628 pp., with 1350 illustrations, including nine plates in full color, in the two volumes. Philadelphia: J. B. Lippincott Company, 1949. $24.00 for the set.

This treatise on urology is comprehensive in scope, covering both the medical and surgical aspects of disorders of the urinary organs. There are special contributions by Drs. Israel Davidson, R. H. Flocks, Russell D. Herrold and David Presman, on laboratory methods, transurethral surgery, chemotherapy and postoperative complications, respectively. The publishing is excellent, and the set should be in all collections on the subject and should be available to all urologists.

NOTICES

ANNOUNCEMENTS

Dr. Melvin K. Lyons announces the opening of his office at 102 Salem Street, Malden, for the practice of urology.

Dr. Daniel J. McSweeney announces the removal of his office to 1180 Beacon Street, Brookline.

Dr. Blake Daniels Prescott, formerly on the staff of the Institute of Living, Hartford, Connecticut, announces the opening of an office for the practice of neuropsychiatry and child guidance at 4 Chestnut Street, Springfield, Massachusetts.

Dr. William C. Quinby, Jr., announces the opening of his office at 1101 Beacon Street, Brookline.

LECTURE ON TUBERCULOUS MENINGITIS

A lecture on the subject "Current Treatment of Tuberculous Meningitis" will be delivered by Sir Hugh Cairns, M.D., K.B.E., Nuffield Professor of Surgery at Oxford University, England, on Monday, June 26, at 12:15 p.m., in the amphitheater of the Peter Bent Brigham Hospital.

ALL-AUSTRIAN CONGRESS OF PHYSICIANS

The Austrian Van Swieten Society for the promotion of medical research and refresher courses for physicians will arrange an All-Austrian Congress of Physicians at 32 Schwarzstrasse, Mozarteum-Salzburg, on September 7 to 9.

The program of the Congress, which will be devoted to the principal subject "The Vegetative Nervous System and Its Relations to Pathogenesis," is as follows:

The Vegetative System — Internal Secretion and Assimilation. Professor Mark, of Rostock.
The Vegatative System and Pathologic Circulation Reaction. Lecturer Siedek, of Vienna.
Pathology of Hypothalamus. Professor Hoff, of Vienna.
The Vegetative Nervous System as the Focus of Operative Interventions. Professor Sunder-Plassmann, of Muenster.

The principal lectures will be as follows:

Latest Achievements of the Physiology of the Human Heart. Professor Bing, of Baltimore.
The Ischialgia and Its Relation to Knee-Cap Affections. Professor Erlacher, of Vienna.
Cyclic Disturbances and Their Treatment. Professor Antoine, of Vienna.

In addition, lectures on all disciplines of medicine are on the program of the Congress.

The Secretariat of Van Swieten Society invites all American colleagues who at present are on a European trip.

REGULAR CORPS EXAMINATION FOR MEDICAL OFFICERS IN UNITED STATES PUBLIC HEALTH SERVICE

A competitive examination for appointment of medical officers in the Regular Corps of the United States Public Health Service will be held on October 9, 10 and 11, 1950, at a number of points throughout the United States, located as centrally as possible in relation to the homes of candidates. Applications must be received no later than September 11, 1950.

Appointments will be made in the grades of assistant surgeon (equivalent to Army rank of first lieutenant) and senior assistant surgeon (equivalent to Captain). In making assignments, consideration is given to the officer's preference, ability, and experience; however, all commissioned officers are subject to change of station and assignment as necessitated by the needs of the Service. Appointments are permanent and provide opportunities to qualified physicians for a life career in clinical medicine, research and public health. Applicants who successfully complete this examination may ordinarily expect appointment as soon as they become eligible.

An applicant for appointment in the grade of assistant surgeon must be a United States citizen at least twenty-one years of age and a graduate of a recognized school of medicine with at least seven years of educational training and professional experience subsequent to high school. The requirements for appointment in the grade of senior assistant surgeon are the same except that the educational training and professional experience subsequent to high school must total at least ten years.

Applicants who will complete these requirements within nine months of the date of the written examination will be admitted, but may not be appointed until they meet the above requirements. Physicians who are successful in the examination and are now serving internships will not be placed on active duty in the Regular Corps until completion of internship. The examination will include an oral interview, physical examination and written objective tests covering basic medical sciences, including anatomy (except for appointment as senior assistant surgeon), physiology, biochemistry, microbiology and pathology, practice of medicine, including internal medicine (including neurology and psychiatry), therapeutics and toxicology, pediatrics, and medical problems of obstetrics and gynecology, practice of surgery, including surgery, orthopedics, gynecology, obstetric procedures, and preventive medicine and public health.

Application forms and additional information may be obtained from the Surgeon General, United States Public Health Service, Federal Security Agency, Washington 25, D. C. (Attention: Division of Commissioned Officers). Applications received after September 11, 1950, cannot be accepted.

SOCIETY MEETINGS AND CONFERENCES

JANUARY 9–DECEMBER 1. Laboratory Courses at Communicable Disease Center, Atlanta, Georgia. Page 950, issue of December 8.

JUNE 23 AND 24. International Academy of Proctology. Page 768, issue of May 11.

JUNE 24 AND 25. American Society for the Study of Sterility. Page 38, issue of January 5.

JUNE 24 AND 25. American Academy of Dental Medicine. Page 640, issue of April 20.

JUNE 25. Western Association of Industrial Physicians and Surgeons. Page 886, issue of June 1.

JUNE 26. Lecture on Tuberculous Meningitis. Notice above.

JUNE 26–30. American Physicians Art Association. Page 428, issue of March 16.

JUNE 26–30. American Medical Association. Annual Session. San Francisco, California.

JUNE 29. 94th Infantry Division Lecture. Page 962, issue of June 15.

JULY 2–5. American Proctologic Society. Page 848, issue of May 25.

JULY 3. Brazilian Society of Cardiology. Page 886, issue of June 1.

JULY 17–22. International Congress for Scientific Research. Page xvii, issue of September 1.

AUGUST 21–26. International Society of Hematology. Page 888, issue of December 1.

AUGUST 28–SEPTEMBER 1. American Congress of Physical Medicine. Page 428, issue of March 16.

AUGUST 31–SEPTEMBER 7. World Federation for Mental Health. Page 306, issue of February 23.

(Notices concluded on page xi)

NOTICES (*Concluded from page 994*)

SEPTEMBER 3–9. International Heart Congress. Page 160, issue of January 26.

SEPTEMBER 7–9. All-Austrian Congress of Physicians. Page 994.

SEPTEMBER 14. Progress in the Management of Hand Injuries. Dr. Henry E. Marble. Pentucket Association of Physicians. 8:30 p.m. Haverhill.

SEPTEMBER 27–29. Mississippi Valley Medical Society. Page 991, issue of December 15.

OCTOBER 12–14. American Association of Blood Banks. Page 428, issue of March 16.

OCTOBER 14–19. American Academy of Pediatrics. Page 962, issue of June 15.

NOVEMBER 1. New England Obstetrical and Gynecological Society. Hotel Somerset, Boston.

JANUARY 31. American Academy of Orthopaedic Surgery (see Kappa Delta Award for Research in Orthopedic Surgery). Page 736, issue of May 4.

APRIL 9–13. American College of Physicians. Page 962, issue of June 15.

CALENDAR OF BOSTON DISTRICT FOR THE WEEK BEGINNING THURSDAY, JUNE 29

FRIDAY, JUNE 30

*9:00 a.m.–12:00 m. Combined Medical and Surgical Staff Rounds. Peter Bent Brigham Hospital.

*10:00 a.m. Surgical Clinic. South End Health Unit, 57 East Concord Street, Boston.

*1:30 p.m. Tumor Clinic. Out-Patient Department. Mount Auburn Hospital, Cambridge.

MONDAY, JULY 3

*11:30 a.m.–12:15 p.m. Clinical Conference. South End Health Unit, 57 East Concord Street, Boston. Dr. Cleaveland Floyd in charge.

*12:15–1:15 p.m. Clinicopathological Conference. Main Amphitheater, Peter Bent Brigham Hospital.

WEDNESDAY, JULY 5

*11:00 a.m.–12:00 m. Medical Rounds. Children's Medical Center.

*12:00 m. X-Ray Conference. Margaret Jewett Hall, Mount Auburn Hospital, Cambridge.

*12:00 m.–1:00 p.m. Clinicopathological Conference (Children's Medical Center). Amphitheater, Peter Bent Brigham Hospital.

*2:00–3:00 p.m. Combined Clinic of all Medical Center Services. Amphitheater, Children's Hospital.

*Open to the medical profession.

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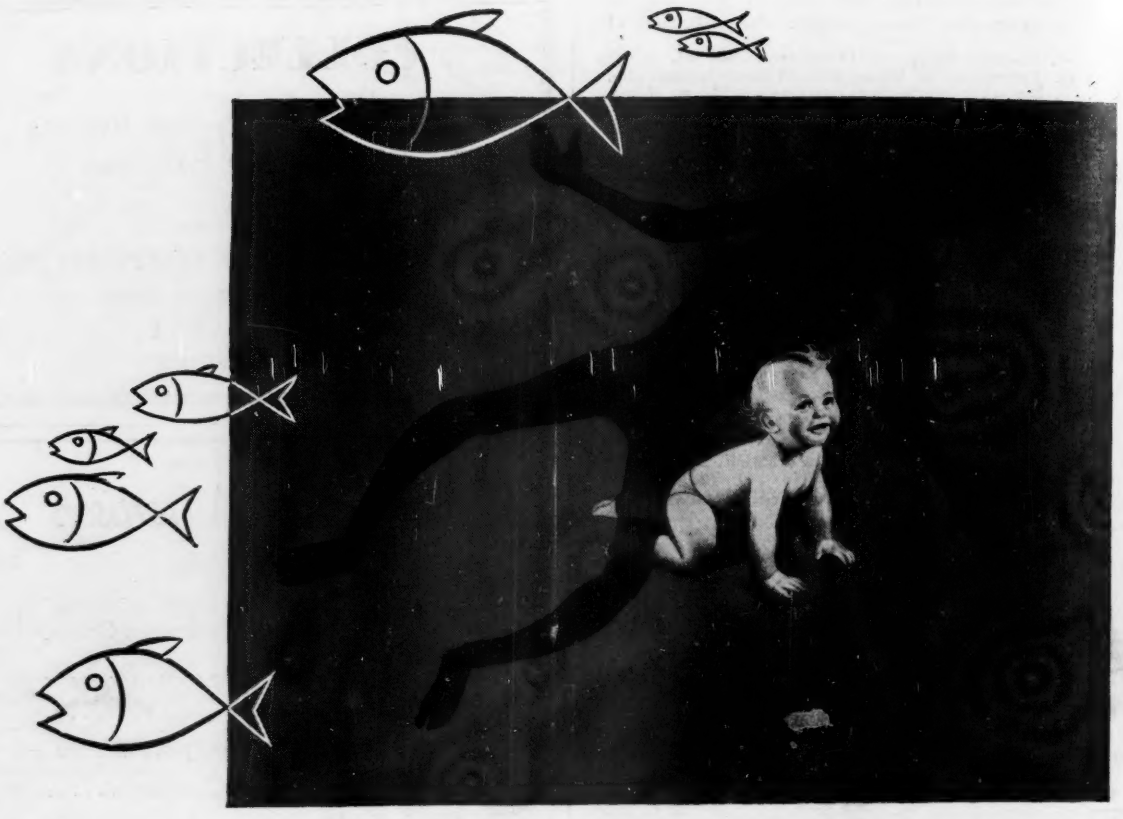

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